GAS

AUGUST 1959

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THE NATION'S NATURAL GAS AUTHORITY

Remote control of a booster station

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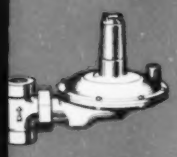

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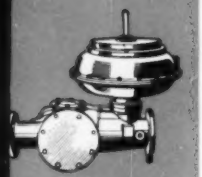

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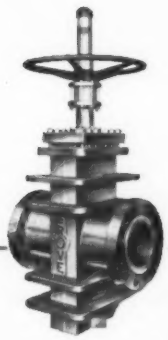

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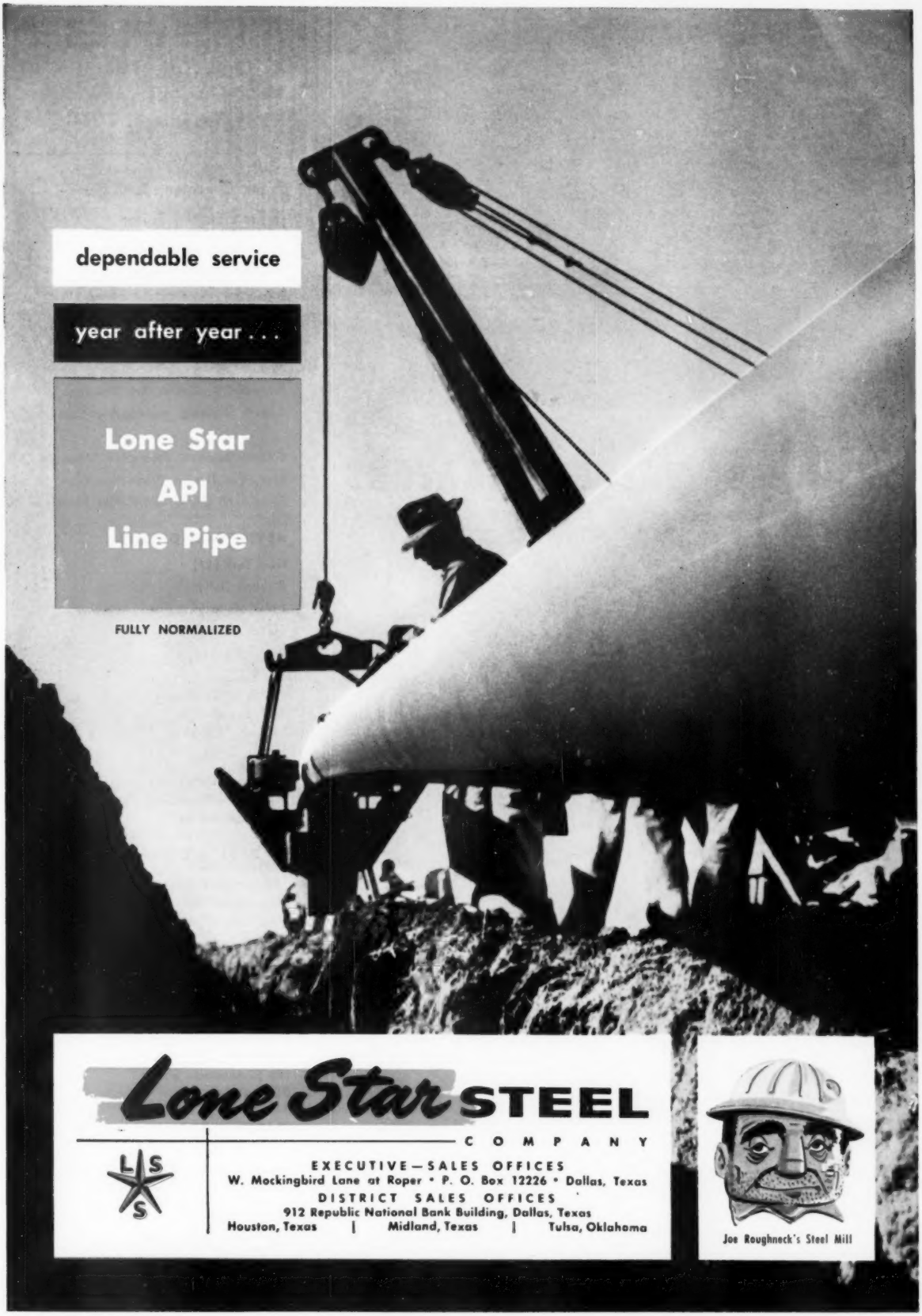

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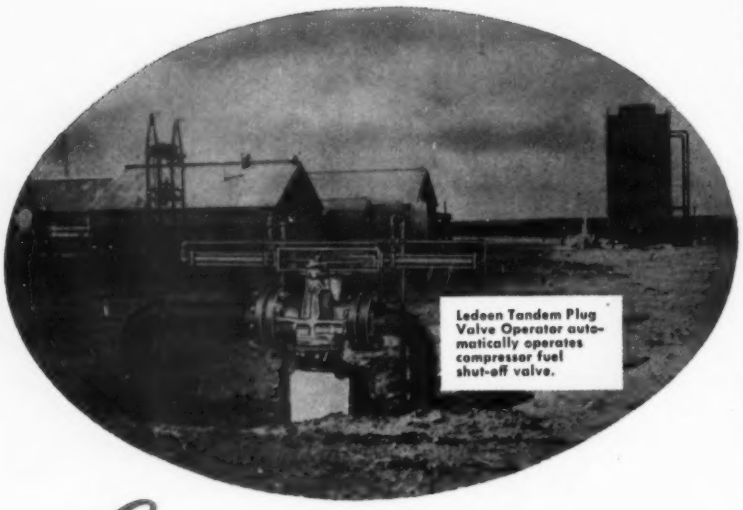

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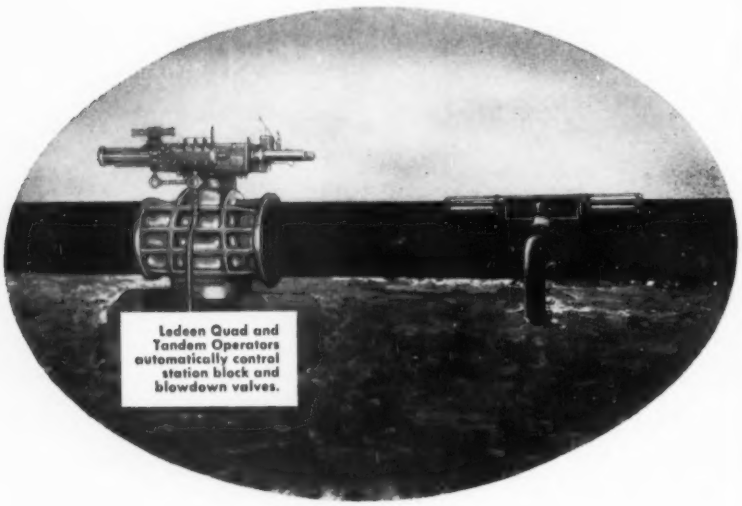

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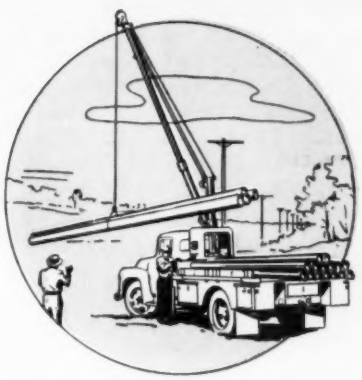

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AUGUST 1959

Thermally Thinking

IT is usually not well to look back. The future is the place to cast one's eyes. If we do quickly flick our eyes into the past of gas measurement, it is immediately evident how unfortunate it is that gas producers, pipeliners and distributors did not anticipate the need for an autonomous body to set up technical standards for commercial gas measurement.

But, what wasn't done should not be lamented. It is fortunate that so many measurement men in our industry now spend a lot of effort to rectify the omissions of the past. The AGA gas measurement committee has compiled and published technical reports detailing recommended practices for metering. More of them are under preparation. The best tribute one can give this work is the fact that those who are interested in fair and impartial accuracy in gas measurement do not hesitate to adopt the recommendations in full.

One of the most important basic omissions in the early days of measurement was the failure to establish some standard unit of measurement. Currently, the most common method of measurement in commercial gas metering is by volume. The Mcf or 1000 cubic feet is, perhaps, the most convenient unit for describing gas movements through systems. Some companies take things a bit further and convert these cubical volumes into Btu, therm, or therms. But most of this type of measurement starts with cubic feet or Mcf.

For those readers who are not dealing with gas measurement regularly, it is well to remember that the total mass of substance in a cubic foot of gas depends upon its absolute pressure and its Rankine temperature (Fahrenheit plus 460—often referred to as absolute temperature).

Therefore, to measure gas in meaningful terms by the volume method, it is first necessary to specify the absolute pressure and Rankine temperature of the cubic foot into which it is to be enumerated. In other words, the base pressure and base temperature of the cubic foot must be established.

Oddly enough, as we mentioned before (see "The Elastic Cubic Foot, GAS, Jan. 1959, p. 87), these bases have never been established on a nationally recognized scope. To be more accurate, I should say that the pressure base has no uniform standard over the nation; actually, the standard base temperature of 520 deg. Rankine has been very well established by general usage.

People directly concerned with measurement are, of course, well aware of the situation. However, I want to urge everyone to take notice of this lack of nationally recognized uniform standard conditions for gas measurement. Ask the measurement superintendent of your company about this situation. You will find, in all probability, that he wants uniform base conditions. However, you may find that he does not want the same pressure base as others of his profession do and he might be discouraged about ever solving the problem.

Such gas measurement matters interlace themselves throughout the operations of your company. Perhaps the most extensive and time consuming function of your company's accounting department is the maintenance of records and the preparation of reports. Transactions involving gas volumes as purchased, produced, exchanged, transported and sold creep into any and all of these reports. Such volumes have to be converted and reported on the particular base used by the agency to which the report is directed. Thus, it is easy to see how much happier the accountants would be if everybody would get on the same set of units and base conditions—they could simply develop enumerations and use them universally.

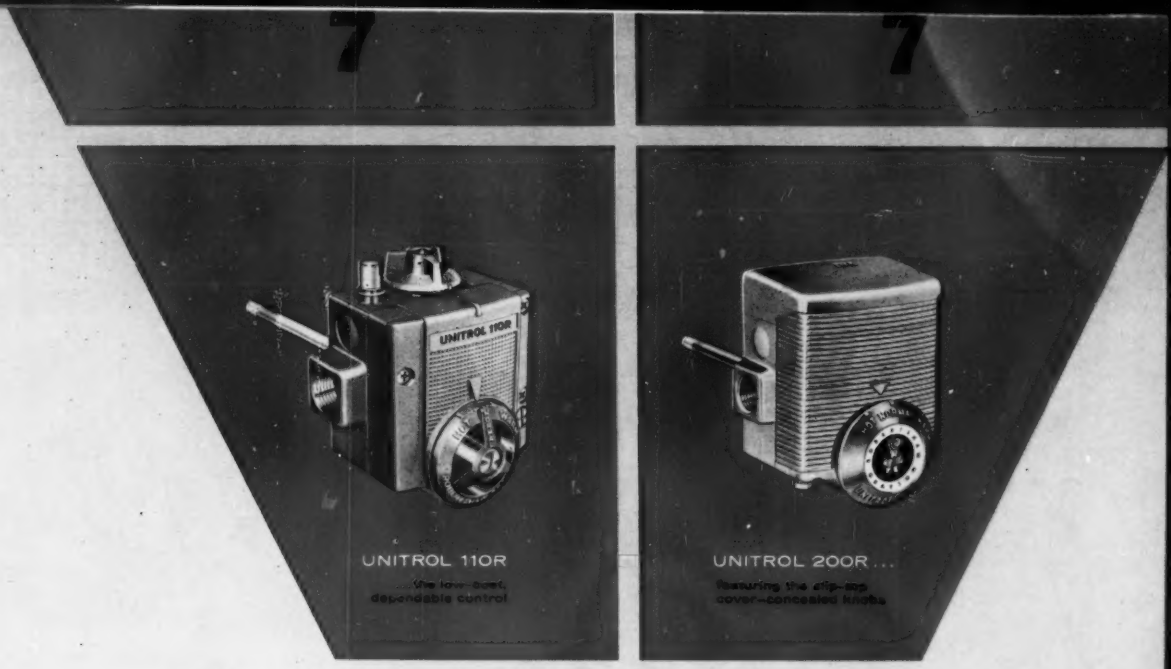
I think the industry should buy and sell the same unit. The unit of gas purchase or production should be the same as that moved in pipelines and the same as delivered to distributors, and, in turn, to ultimate consumers. Currently, the cubic foot is elastic and it is not the only unit used in commerce of gas.

Management in particular should become more aware of the gas measurement situation in respect to the lack of standards for either conditions or units. The ultimate goal is measurement of gas by weight. It is sure to come.

I urge gas company management to join their measurement engineers and gas association measurement committees in taking action to bring about nationwide standardization for gas measurement.

J. Fred Ebsen

EDITOR



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GAS HIGHLIGHTS

Transwestern faces another delay

Transwestern Pipeline Co. won't get its certificate before September at the earliest, despite Presiding Examiner Frazee's recommendation for approval. Oral arguments, originally set to start July 14, didn't get underway until July 23, with strong opposition on price furnished by FPC staff. Now, with the commission ready to take its annual vacation during August, no decision will be forthcoming until September or later.

Gas light approval in the offing

AGA may set up requirement specifications and issue approvals for gas lights. A committee is being formed now to look into approval possibilities. Any definite action is probably a year away, though, at the earliest.

California starts off-shore production

First deliveries of California off-shore gas probably will start in September. Pacific Lighting Gas Supply Co. will receive the gas from a Standard (California)-Humble platform located in 90 ft of water off Summerland, between Santa Barbara and Ventura. Initial deliveries are expected to total 1 million cu ft a day. In six months, this production probably will be doubled.

British Columbia discoveries boom

Between 4 and 5 trillion cu ft of natural gas was discovered in British Columbia in the past 12 months. That's the report of Westcoast Transmission President Frank McMahon, who says the discoveries will take care of a good portion of Westcoast's future requirements. McMahon also predicted that the pipeline's current sales of 350 MMcf/day will rise to 835 MMcf/day in 1964-65.

Northern plans new storage field

Northern Natural Gas Co. wants to develop the nearly depleted Otis field in south central Kansas for underground storage. In its FPC filing, Northern said it ultimately plans to store 182 billion cu ft in the field. The pool will be capable of delivering 245 MMcf daily in 1962, and when fully developed in 1963, will produce 350 MMcf daily. Cost of the project is estimated at $20 million.

Delaware passes new utility bill

The Delaware legislature has passed a bill requiring utilities to bear the cost of rate hearings and investigations by the State Public Service Commission. Maximum charge made on any one utility cannot exceed $50,000 per year. Commission must submit an itemized bill to the utility.

California still leads in heating

GAMA has announced that California again would lead the way in adding new gas heated homes. The Golden State now tops all others with 3,881,000 gas heated homes, will add 180,000 more this year. GAMA also predicts that by end of the 1961-62 winter season, California will have 4,433,000 homes heated with gas.

El Paso-PNW file for big project

FPC has accepted applications from El Paso Natural Gas Co. and Pacific Northwest Pipeline Co. seeking approval to build a $58.8 million pipeline to bring more gas to southern California. Under the proposal, El Paso will build 395 miles of 34-in. line from Thistle, Utah, to the California-Nevada border southwest of Las Vegas. El Paso would purchase gas from Pacific Northwest and Colorado Interstate, and sell to Southern California and Southern Counties Gas Cos. Deliveries would total 470 MMcf per day.

Lone Star gets new gas supply

Dallas' Lone Star Gas Co. has signed a 20 year contract with Coastal States Producing Co. which will provide it with 267,000 MMcf of proven reserves. Under the agreement, Lone Star will purchase the gas production of 30,000 acres in North Texas owned by Coastal States. Deliveries are expected to start in May or June of next year.

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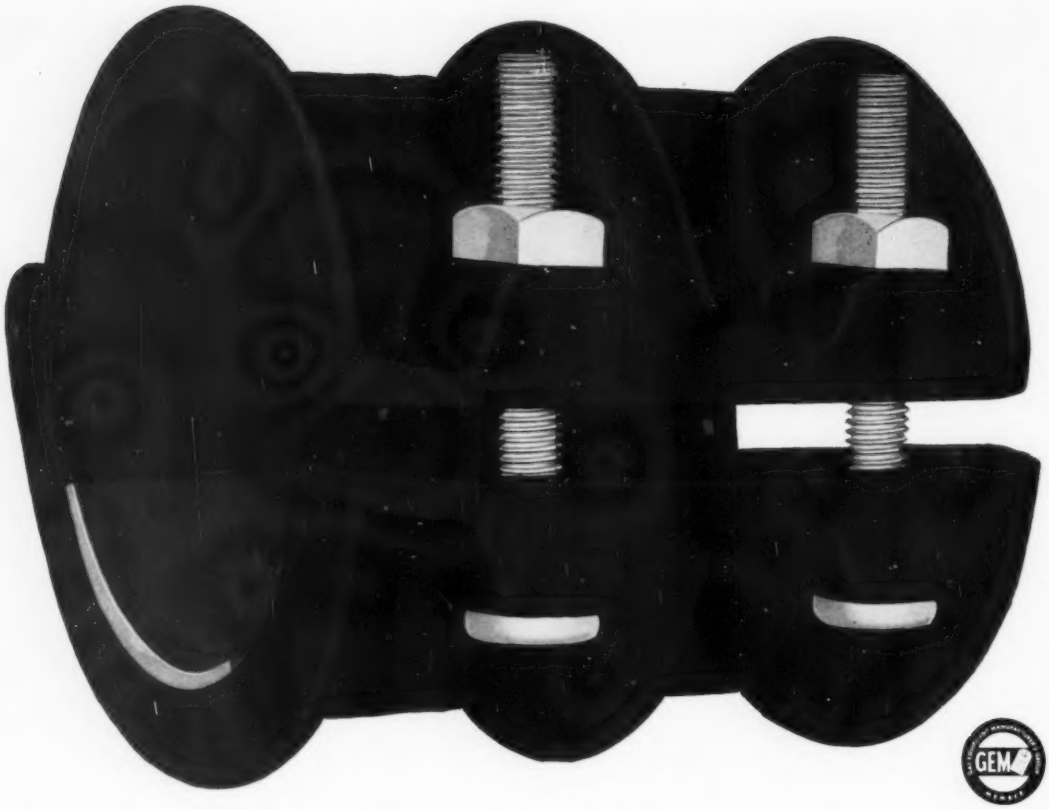

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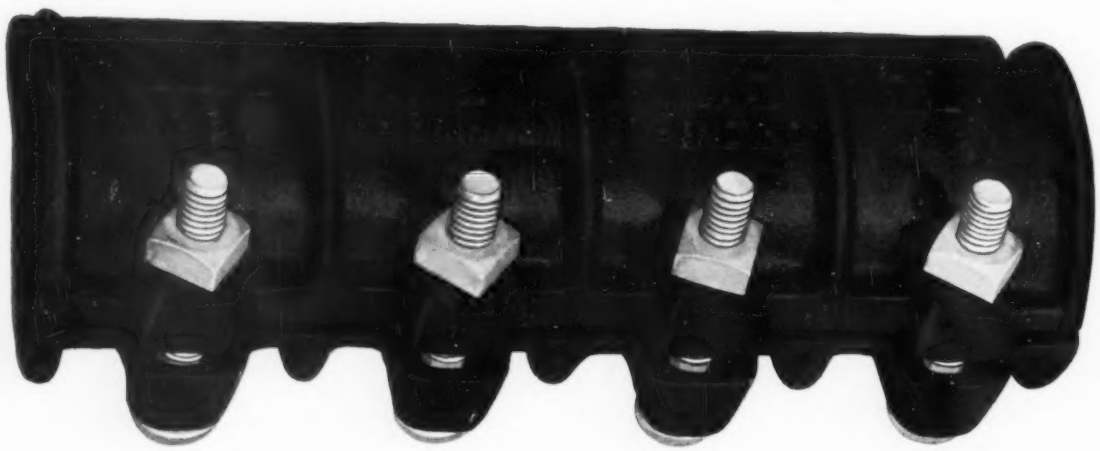


Regulatory progress

WITH extraordinary expansion in demand for most public utility services, large sums of new money must be attracted from investors. Financing and changing of consumer rates to keep up with growth and its Siamese-twin inflation continue to occupy much executive time and planning.

• Corporate finance

The fact that overall corporate financing has held up so well is primarily because public utility new construction programs have been continued in spite of the recent recession. According to latest available reports from the Department of Commerce and Securities and Exchange Commission, public utilities planned construction expenditures for the future are still in excess of their record outlays for the past. Were it not for the utilities continued record high construction expenditures and consequent need for heavy new financing, the overall declines that have been registered in these fields would have been substantially larger than they were. The ability of the utilities to finance successfully and economically, which depends to a large extent on a good earnings record, is an important bolster to the general economy.

It is apparent that long-term interest rates generally will remain at relatively high levels and will probably trend upward as the economy once again expands and inflationary pressures reassert themselves. In view of the tremendous economic expansion anticipated in the 1960's, the long-term outlook for interest rates is upward, as the trend has been since 1946. Since then, each peak period in interest rates has been higher than the previous peak. Recognition by utility commissions of this continued high cost of money is a requisite for the years ahead if utilities are to maintain the growth necessary to sustain the dynamic economic expansion expected.

Relative to common stocks, one of the significant facts of the recent business recession was that no liquidation of stocks on a large scale took place. One of the principal reasons for this was the widespread conviction on the part of investors that the recession was only of temporary duration and that long-term inflation is a greater threat than the recession.

Even considering their gains, utility stock prices do not compare to advantage over other investment opportunities. Manufacturing stocks have doubled the best performing utility stocks in the last 20 years. The relatively poor long-term performance of utility stocks demonstrates the necessity for improvement. Accepting the prediction of long-run inflation, it is doubtful that utilities will compete satisfactorily with other common stocks unless they can improve their market performance.

• Inflation and regulatory recognition

The element of inflation is gaining recognition in utility rate-making.

As the economy continues to become inflated, operating costs, among other things, continue to mount. The problem that faces regulatory agencies is from time to time how to keep this slippage from becoming so pronounced that it results in deterioration in the overall financial condition of a utility company. It is inevitable in that kind of situation that the public interest must suffer because the company is then sent into the money market in a disadvantageous position. So the problem facing regulators, who must determine plant valuation of companies, is how to give proper effect to current economic conditions.

The public utility commissions have a variety of methods for compensating for the erosion in earnings caused by higher costs of materials, labor and capital.

The Montana commission recognizes attrition as an aspect of rate cases in these inflationary times. It prefers to base its findings upon actual operations rather than a test period because of indefiniteness of projecting future operations. Once the results are obtained the commission considers the matter of attrition and what effect future times will have upon the rate of return. In one recent case the future effect upon the rate of return would have been drastic deterioration. A higher rate was granted.

New Hampshire Public Utilities Commission provides an allowance for attrition based on a judgment figure arrived at by applying the allowed rate of return to the difference between the average and year-end rate base.

Ohio statutes require the commission to use as the rate base reproduction cost new less *existing* depreciation. This is considered to provide a cushion against the impact of attrition. In addition, the Ohio commission annualized the

most recent wage increases granted by the utility and allowed the full amount as known increased items of expense.

The New York Public Service Commission has no formula for the treatment of the attrition factor. It does give consideration to the factor and treats it on a case by case basis. An allowance for attrition (defined as decreased earnings per unit of property) was made in a case on the basis of three-tenths of one per cent per year. This "attrition" factor was then applied to the indicated rate of return which was found to be reasonable.

The New Jersey Department of Public Utilities in a recent case provided for attrition through finding the depreciated original cost and adding a reasonable allowance for the net investment to establish a "fair value" base. It then found that a rate of return ranging from 6 per cent to 6.37 per cent is reasonable.

The West Virginia Public Service Commission utilizing an original cost average investment rate base authorized a rate of return of 6.35 per cent. Included in adjustments to operating expense was an unspecified amount allowed for attrition. Considering the attrition factor in this manner, rates were established on a scale to permit the rate of return found to be reasonable.

The Delaware commission utilized a fair value rate base which comprehends both original cost depreciated and current cost depreciated with such weight accorded each valuation as the commission feels is proper in the particular case. The rate of return provided on the rate base established as outlined is felt to be sufficient to compensate for attrition without any separate consideration.

The following conclusions result from a study of commission decisions.

A generally accepted definition of attrition as applied to the utility industry is:

> It is the decline in the per cent earned on the rate base due to the replacement of plant items at price levels higher than those experienced when the original plant items were installed; it also comes about by additions to plant at a unit cost higher than the average cost of existing units.

Attrition is a direct result of inflation or the decline in the "real" value of the dollar.

The majority of regulatory agencies are cognizant of attrition as a factor in the rate making process today.

No single method of dealing with or providing for the attrition factor has been evolved. This is due in some degree to the different types of rate base utilized by regulatory agencies.

Those regulatory agencies adopting a present fair value or reproduction cost new rate base feel that the rate base itself compensates for any erosion brought about by the attrition factor.

The agencies adopting the net investment rate base deal with attrition in one of three ways:

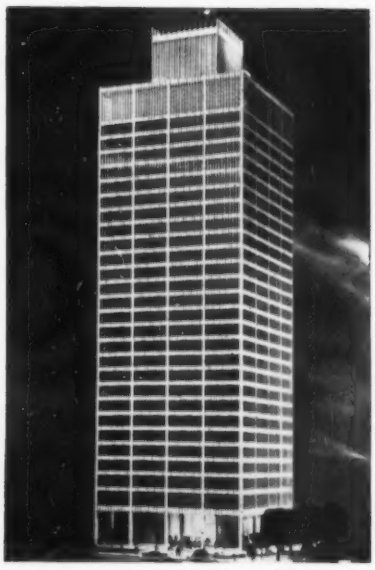
(1) By an addition to the rate base to include a sum for extraordinary investment made by the utility; or

(2) Through an adjustment upward to the rate of return authorized as reasonable by the agency in view of the existence of the attrition factor; or

(3) Through the use of a year-end rate base where previously rates had been established on an average investment rate base.

Attrition will remain a factor in the utility rate-making process for the future. ■

Mich Con to build Detroit Skyscraper



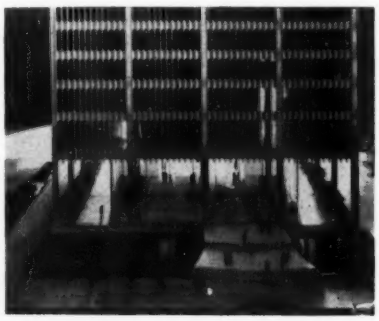
This $20 million Detroit skyscraper will house the headquarters offices of Michigan Consolidated Gas Co., Michigan Wisconsin Pipe Line Co., and American Louisiana Pipe Line Co.

The main shaft will have 28 floors, topped by a four-story crown. One of the most unusual features will be the six-sided window design, eliminating all horizontal lines from the superstructure. The design stressed the vertical lines of the supporting columns and window dividers.

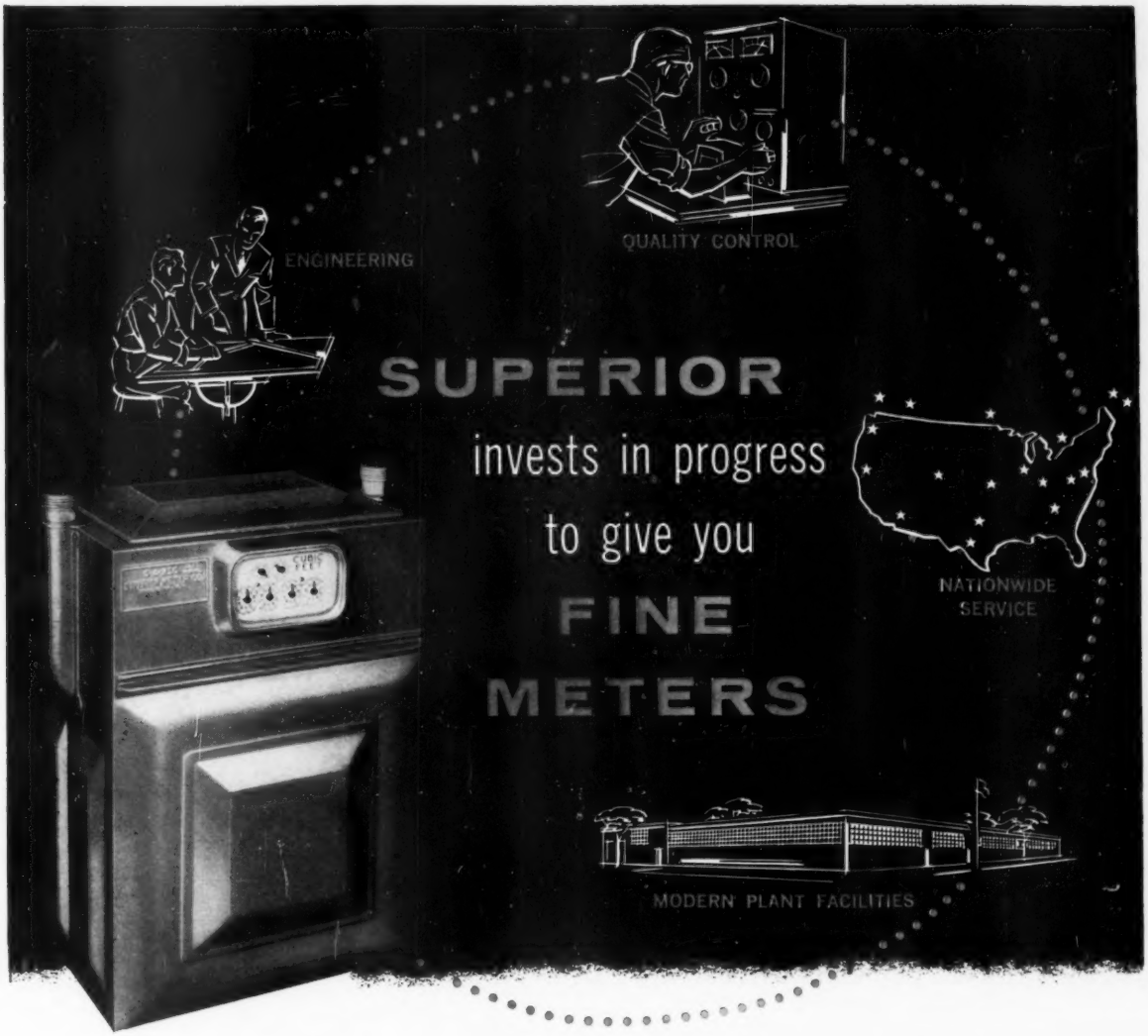
Minoru Yamasaki—Smith, Hinchman, Grylls, Associated Architects and Engineers, combined operations on the project. Yamasaki conceived the design. Smith, Hinchman and Grylls is responsible for architectural engineering.

The white exterior of the building will be of chips of marble or quartz, bonded together with cement and honed to a smooth finish.

A bridged reflecting pool running the width of the building sets the main entrance off from the



street. The 30-ft high lobby has all glass walls stepped back from the perimeter of the building to form an arcade around the entire first floor.



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16

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TECHNICAL TRENDS

By GUY CORFIELD

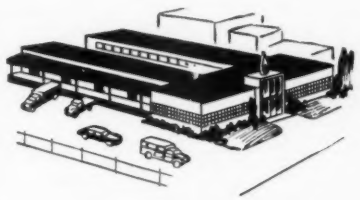
Heat and temperature

The rapid production of heat energy and high temperatures developed in engines for propulsion of space ships, and the frigid surroundings of space, make us more conscious of temperature extremes. To develop the proper concept we should realize the *difference between heat and temperature.* To follow the literature we have to understand various temperature scales in use.

The two words, heat and temperature, are often used interchangeably and improperly. Two different concepts are involved. Heat is energy which can be added to or removed from a substance, body or system. It either increases or decreases contained energy. Temperature, in the units or scale selected, is an index of the intensity level of contained energy. The ability of one object or system to transfer heat energy to another is a function of temperature difference of the two objects or systems. Using a water analogy, and falling water as an energy source concept, the amount of water corresponds to heat. The height or distance of fall is analogous to temperature difference. Everything we come in contact with contains heat. But, in comparison with the temperature of our body, some things feel "cold" or "hot."

The most frequently used scientific temperature scale was developed by and is named for Lord Kelvin. It is in centigrade degrees, called Kelvin, and abbreviated as K. On this scale, absolute zero is designated as 0 deg K and is equivalent to —273.16 deg. C. Therefore the freezing point of water at atmospheric pressure (0 deg C) is 273.16 deg K. The boiling point (100 deg C) is 373.16 deg K. These two K figures correspond to 32 deg F and 212 deg F. There is also an absolute Fahrenheit temperature scale, called Rankine and abbreviated as R. Absolute zero (or 0 deg R) on this scale is equivalent to —459.6 deg F. As an approximation for very low or very high temperatures, the K or C figures can be converted to R or F by multiplying by nine-fifths.

The highest temperature that can be attained by a chemical reaction (such as burning) is about 5000 deg K. For the normally used



fuels and oxidants max temps are not much above 3000 deg K. Ordinary electric arcs and discharges can develop over 5000 deg K. The flaming electric discharge approaches 10,000 deg K. A plasma jet flame (dissociated and ionized gases) can reach almost 20,000 deg K. Very intense "pinch effect" electrical discharges have produced instantaneous temperatures estimated in the range of several hundred-thousand degrees. Temperatures in the nuclear fission bomb are in the vicinity of one million deg K, and in the nuclear fusion (hydrogen) bomb about 100 million deg K.

At the other end of the scale, low temperatures are associated with those of liquefied gases at atmospheric pressure. Some of these are (in degrees C): oxygen, —183; nitrogen, —196; hyrogen, —253; helium, —269. In degrees K they are: oxygen, 90; nitrogen, 77; hydrogen, 20; helium, 4. Liquid helium is only 4 centigrade degrees above absolute zero. This is the lowest temperature so far attained by man. It is very near the ultimate of human effort, as scientists believe that absolute zero is theoretically unobtainable.

As regards the *temperature in outer space,* Drs. Fiske and Schmitt, of General Electric research laboratories, have written as follows: "Much half-truth has been written about the 'cold' of outer space, suggesting that we may soon have convenient access to temperatures near absolute zero. But space has no temperature—we can consider only the temperature of a body placed in empty space.

"A black body orbiting around the sun at the earth's distance receives radiation from the sun and reradiates it to space. If it is a good heat conductor, or if it rotates rapidly, exposing all sides to the sun, it will assume a temperature of about 300 K. If it is a perfect insulator and one side faces the sun continuously, that side will reach a maximum temperature of about 400 K. The other side, though, would continuously radiate its heat store without replenishment, asymptotically approaching absolute zero. Stellar radiation and interplanetary gas would probably maintain the dark side temperature at a few degrees absolute.

"In practice, then, a space ship or an artificial satellite would have very low temperatures available only if the cold zone were carefully shielded from seeing the sun, the earth, and any of its own supporting structure. We calculate that great care would be required to attain even 20 deg by radiative cooling. A fair conclusion: if a need develops in outer space for temperatures in the liquid helium range, that need will be met as here on earth with a helium liquefier."

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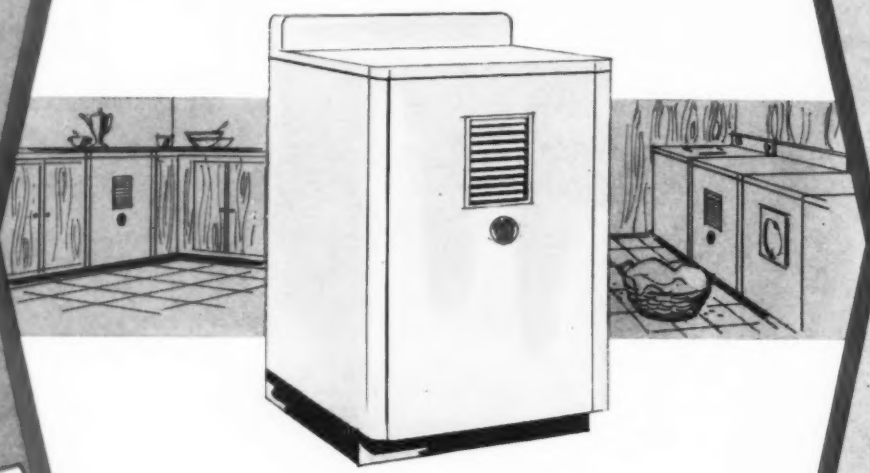

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WASHINGTON

By NEIL REGEIMBAL
GAS Washington Bureau

Coal men plan new invasion

GAS distributors will be facing real competition from the coal industry for consumer and industrial markets in the future.

The new coal drive to "invade the gas and oil markets" is no idle bluff. The recently formed American Coal Sales Association and the Coal Policy Conference are charting an all-out campaign which the gas industry will be hard-pressed to defend against.

In the past, the coal industry through this or that organization has been expert at crying, screaming, and shouting at wounds the gas and oil industries have inflicted. This is no longer true.

The new conference and sales organizations are cranking up a full-blown self-help program. Reportedly, some $1.35 million will be spent in the first year to push coal sales —$1 million for advertising (already submitted by a Baltimore agency for approval) and the rest for public relations campaigns.

The old warrior of the coal industry, Tom Pickett, has reportedly been "sent to the showers."

The plan is to create a central coal industry organization including producers, retailers, research groups, and miners. Put under one tent, this group could finance and push a massive public relations and advertising program.

This new "tent," the conference, has started the plan in motion. Only the coal industry wage bargaining organizations are not signed up—and they probably won't be.

The new paid president of the group, together with a streamlined board of directors, will set up divisions under vice presidents to handle public relations, marketing, research, statistical and economic data, and legislative relations.

They will concentrate on trying to convince consumers that as long as natural gas pipelines are permitted to sell (or "dump" as they put it) gas at low prices to industrial customers, prices to consumers will continue to rise.

A New York public relations agency is drawing up this push on what they hope will be a total of $5 million over the next several years. The final outcome, the smoke-and-soot industry hopes, will be "gas conservation" legislation to severely limit industrial sales of gas.

One peg they'll use is the 1955 report of the President's Cabinet Committee on Energy and Fuels. This alleged that sales by pipelines to industry "which drive out competing fuels" at prices which do not return cost plus return on investment should be banned.

There are indications too that the coal industry is ready to cut its prices to help compete with gas and oil.

Recent FPC hearing records reveal that a coal seller has offered a big buyer a contract at about $1 a ton less than the comparable price of gas. Martin Burke Jr., president of the Northwestern-Hanna Fuel Co., Minneapolis, a subsidiary of the huge Consolidated Coal Co. of Pittsburgh, told the commission:

"If the gas company (Minneapolis Light & Power Co.) lowers its price, we will make every effort to meet it in order to assure the continued use of our coal in these utility plants." A spokesman for a Sheboygan, Wis., coal company echoed the offer regarding its utility customers.

The Coal Sales Association, the National Coal Association, and other huge coal industry groups are linked with the conference through directorships. It has taken the first steps toward a concerted drive to sell more coal to small factories, apartment houses, hospitals, schools, and other public buildings. This "intermediate market" between home consumer and big industry could be a "bonanza" for coal producers, the group says.

The plan would involve cooperation between coal firms to make certain proper stokers are available and to arrange easy credit for purchasers.

Meanwhile, the coal industry is bringing a "ringer" into the battle for markets.

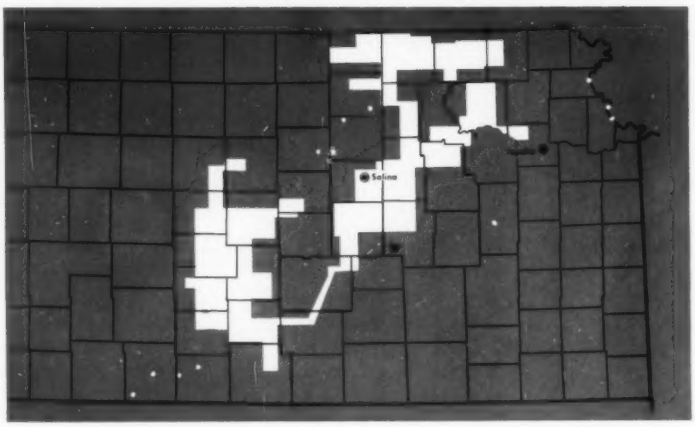
Unable apparently to match the gas industry with convenience and cleanliness, or the electric industry with Betty Furness, the black gang boys are enlisting the aid of an expert competitor—Uncle Sam.

In mid-June, the House approved by a whopping 251-54 margin legislation to put the U. S. government squarely into the battle for industrial and consumer fuel markets. And instead of paying their new ally, the government under the measure will pay the coal industry to the tune of a $2 million or more in research.

As passed by the House, the measure would create a three-man independent government agency which would hire a professional staff and proceed to find ways to cure problems facing the depressed

Continued on page 88

In Kansas...they save up to 40% on service replacements



The Kansas Power and Light Company cuts labor and material costs with tubing of Tenite Butyrate

The Kansas Power and Light Company serves natural gas to more than 100 communities in the Sunflower State. Faced with an increasing number of service replacements and a rising cost per installation, this utility began to evaluate plastic service replacements in 1956.

The plastic they chose was Tenite Butyrate—the first choice of major natural gas distributors throughout the country, according to a recent survey by GAS Magazine. Butyrate tubing has won this favored position because it offers many advantages.

One of the most important advantages of the tubing is its flexibility, which makes it easy to insert through old metal lines and saves costly re-trenching. And the smaller diameter of the inserted tubing does not reduce flow since its extremely smooth walls permit greater flow under the same pressure than does metal pipe of the same size. Its availability in coils from pipe extruders also helps to simplify storing, transporting, and handling. *(An American Gas Association report recommends that only Butyrate tubing may be coiled for shipment.)*

The Kansas Power and Light Company found that in services of 70 ft. or more, they could save approximately 40% in total installed cost using Butyrate replacements rather than metal. The economy did not stop with installation, however. Virtually non-corrodible, and an excellent dielectric, tubing of Tenite Butyrate cut maintenance to a minimum.

Since 1943, tubing of Tenite Butyrate has been widely used in the gas industry, for service replacements as well as for new services. Moreover, some gas utilities have installed *mains* of extruded Butyrate pipe.

Discover how you can share in the benefits offered by this Eastman plastic. We will gladly send you a list of manufacturers of extruded Butyrate tubing and pipe. Write: EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENN.

A 16mm. sound-color film, "Plastic Pipelines," is available upon request.

TENITE
BUTYRATE
an Eastman plastic

By MARSHALL E. PARKER

Traps and pitfalls for the corrosion engineer

IN principle, the application of cathodic protection to a system of underground piping is extremely simple. In practice, it can become frustratingly complicated. Some of these complications are inherent in system complexity and its environment (including other systems). Some are the result of imperfect or incomplete knowledge of the system. Many are due to various human frailties. The latter include those of the corrosion engineer himself, as well as of others.

Difficulties with variations in soil resistivity are to be expected. Problems of interference with foreign structures are likewise; but there are many little difficulties and problems which, largely because they are unanticipated, can give trouble beyond their size.

One group of these has to do with insulation—the flange or joint insulation which is so essential to a cathodic protection system. It separates the thing which we are trying to protect from other structures which would be heavy burdens on the system. These joints can be short-circuited by such things as gauge lines, ladders, hand-rails — even guy-wires; all things which are not likely to appear on piping diagrams. For this reason it is advisable for the corrosion engineer, or someone who really understands what the purpose of the insulation is, to inspect each installation in person. This is advised in the case of a preliminary specification of which flanged joints to insulate. Too often there are short-circuiting elements which do not show on the diagrams.

Another gremlin which can short-circuit insulation is lightning. Lightning does not have to strike the pipeline, or any device connected to it, in order to do this. It does not even have to strike close to the affected joint. All that is required—especially in the case of a well-coated line in high resistivity soil—is a stroke to earth somewhere in the vicinity of the line. When the magnetic field surrounding the stroke collapses, the line, being a long conductor lying within the magnetic field, will have a surge induced in it. This will take the form of a steep-front wave which may have an amplitude of several thousand volts. This wave will travel down the line at very high speed, gradually losing voltage. The rate of loss, or attenuation, depends on the soil and coating. A bare line will dissipate the surge in a few hundred feet. Little trouble is experienced in low resistivity soil, even with a well-coated line. In the combination mentioned above, however, the wave will travel for very great distances. When it reaches an "end," that is, an insulated joint, it will be reflected, with the voltage being doubled. It is at this point that damage is likely to occur. Such a wave can easily arc through a 1/32-in. thickness of insulation used for sleeves. It can carry with it an arc which will fuse enough metal to bridge the gap from flange to stud.

The repair of such a short usually requires the one-at-a-time inspection of studs and their insulating sleeves, *after* it is found that the joint is shorted. Meanwhile, depending on the circumstances, there will probably be a total or partial loss of protection of a line section from the time of damage to the time of repair.

In connection with insulated joints, it should be pointed out that a joint is not "shorted" by being buried uncoated. It is quite possible to maintain protection on one side of such a joint. And without undue loss of current to the line on the other side. There is, however, a very real danger that damage may be done on the unprotected side by current leaking off and by-passing the joint via the earth path. The same thing is true of a line carrying a conductive medium, such as water. Even salt water does not short the joint to anything like the degree that a solid metallic connection would—and the amount of damage done by current by-pass is likely to be quite small.

Another question often comes up concerning insulated joints. It is a question the answer to which is an apparent contradiction to the statements just made. Field men will frequently test an insulated joint with either an ordinary ohmmeter or a welding machine and pronounce it shorted because the ohmmeter reads virtually zero, or because it is possible to weld on one side of the joint with the ground connection on the other. In both cases it is not realized that the earth path between two sections of line, even with good coating, is to be measured in tenths of an ohm, and often even less. The usual ohmmeter will rarely indicate any difference between, say, one ohm and a dead short. Hence, it cannot tell the difference between an insulated joint and a shorted one—provided both sides are connected to a long buried pipeline.

An opposite difficulty is that of joints which are unintentionally insulating. Various types of mechanical joints are well known to be trouble-makers in this regard. But sometimes even screwed joints can be almost perfectly insulating—if the right (or wrong) type of thread compound is used. One example is known in which approximately half the services in a fairly

Continued on page 156

It's only natural... that the maker of the world's finest thermostats... also makes the world's finest water heater controls. Now all new, with or without built-in pressure regulators.
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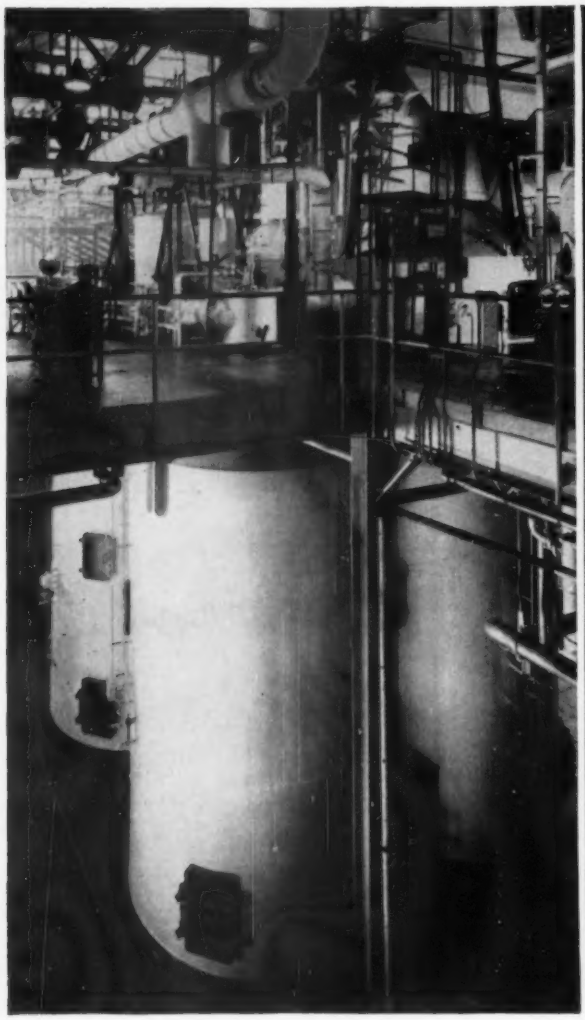

The *real* cost of peak load facilities

How can peak load production equipment costs be gaged? In terms of initial investment, maintenance and depreciation, usually. But if the equipment proves inadequate to meet unusually heavy peak loads, and extra gas must be purchased at *premium prices*—then the cost of the equipment has grown unpleasantly high.

United Engineers is uniquely qualified to help you develop the necessary stand-by equipment for your maximum anticipated load. Our long experience in designing and installing gas production equipment of many types and capacities can be of practical service to you. You may need a reliable LP gas plant, a high Btu oil gas apparatus—or even the flexibility, high capacity, and economical operation of a UGI Cyclic Catalytic Reforming (CCR) Unit. Whatever your requirements, our background of 75 years' experience assures you of maximum return for every dollar expended.

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New Ford F-100 4-wheel drive Styleside pickup handles heavy loads and makes its own road.

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Ford 4-wheel drive trucks are available in ½- and ¾-ton pickups, chassis-cabs and ¾-ton stake models. See your Ford Dealer . . . save hundreds of dollars on America's lowest-priced 4 x 4's with Six or V-8!

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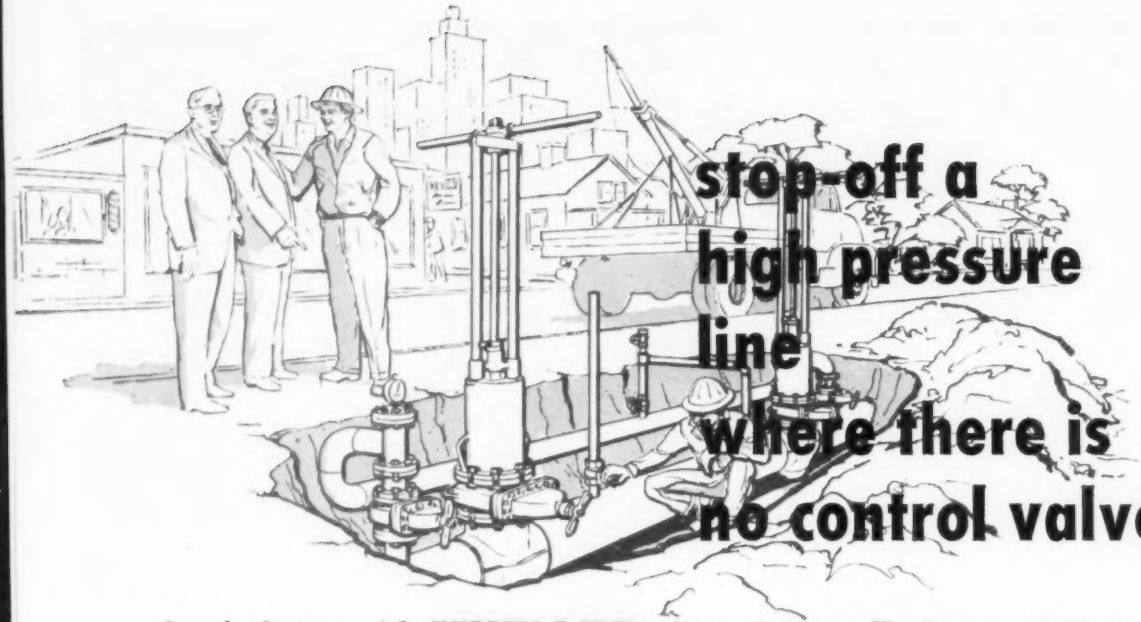
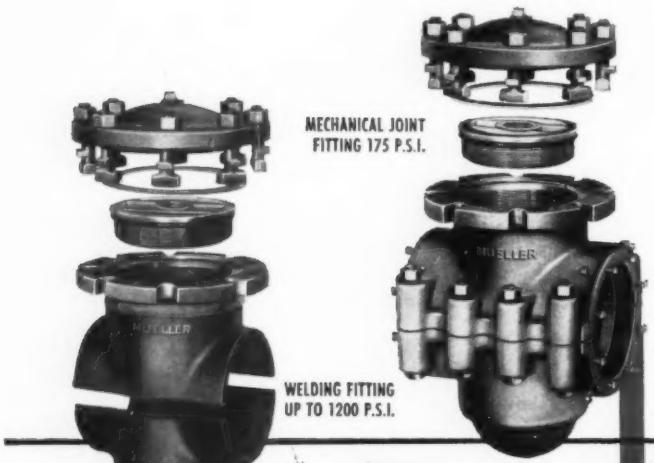


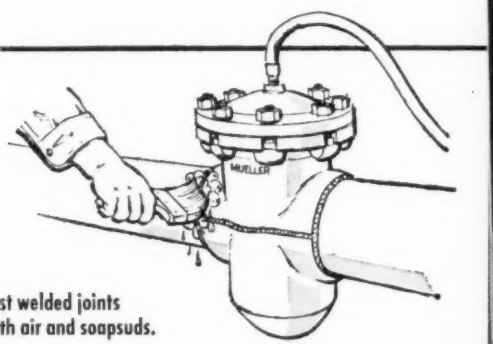
stop-off a high pressure line where there is no control valve!

here's how — with **MUELLER®** *Line Stopper Fittings and Equipment*

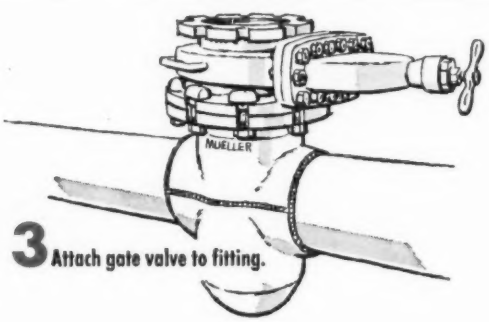
These drawings quickly outline the basic procedure used in stopping-off a line under pressure with Mueller Line Stopper Fittings and Equipment. Line Stoppers may be used at any point—regardless of the location of regular shut-off valves—on any type of line. A single stop-off is illustrated—such as might be used to extend a dead end or to transfer service to a new line. To completely isolate a section of line to repair leaks, make tie-ins, run laterals or install or replace equipment, two stop-offs would have to be made. A by-pass line around the isolated section would then carry the flow to give uninterrupted service downstream.



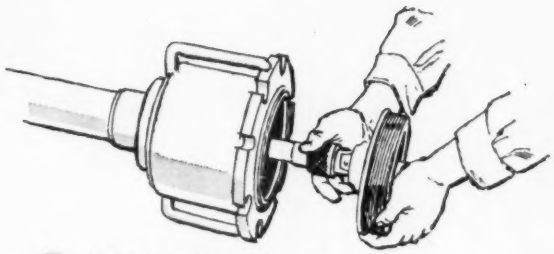
1 Weld fitting to line.



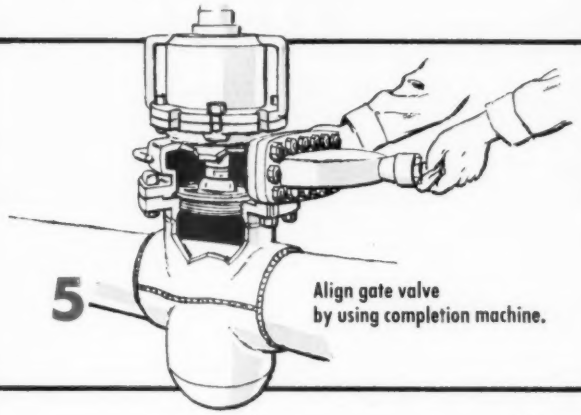
2 Test welded joints with air and soapsuds.



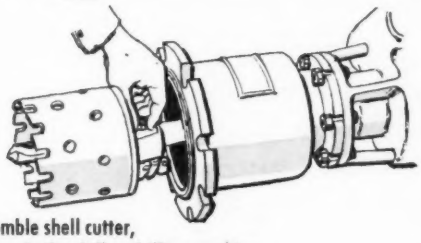
3 Attach gate valve to fitting.



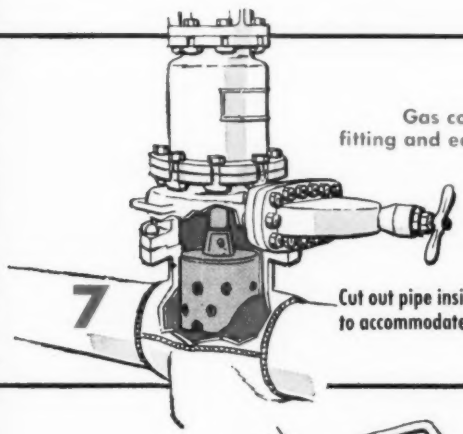
4 Assemble completion plug and aligning tool to completion machine.



5 Align gate valve by using completion machine.



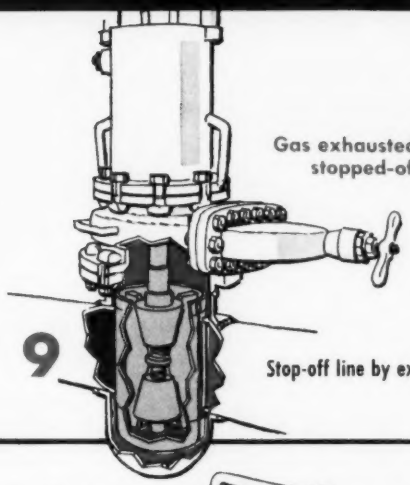
6 Assemble shell cutter, hub and pilot drill to drilling machine.



Gas contained by fitting and equipment.

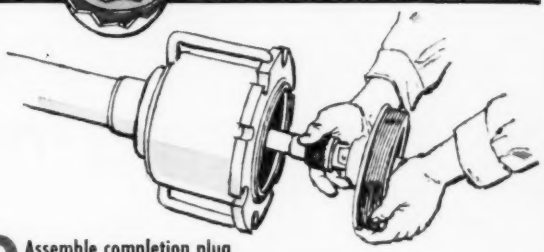
7 Cut out pipe inside of fitting to accommodate cylindrical stopper.

8 Assemble steel wedge stopper to stopping machine.

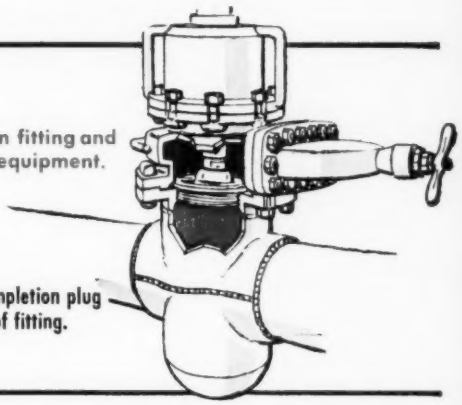


Gas exhausted from stopped-off portion of line.

9 Stop-off line by expanding stopper.

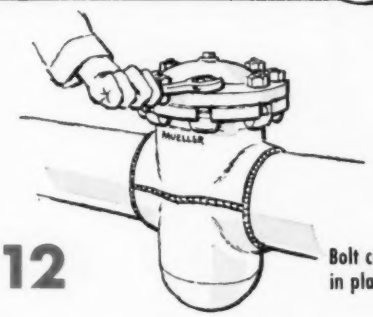


10 Assemble completion plug and inserting tool to completion machine.



Gas sealed within fitting and exhausted from equipment.

11 Insert completion plug into top of fitting.



12 Bolt completion cap in place on fitting.

NO-BLO®

These illustrations show only the major steps in the use of Mueller Line Stopper Fittings and Equipment.

For the full story and specifications on Mueller's complete line, write direct to:

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YOU CAN'T STUMP THE *FISHER/MAN* ON

SAFETY

take your choice of...*RELIEF*...

FISHER CONTROL VALVES

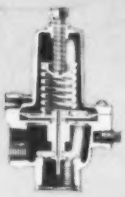
provide positive low pressure system protection to fit your method...

Fisher offers the gas man peace of mind. If he believes in venting excess gas when a district regulator fails, Fisher offers him a choice of precision relief valves to handle the situation. If he prefers complete shut off in case of failure, Fisher has the safety shut off valve to do the job. For monitor or dual protection, Fisher can supply just the type of regulation needed for maximum safety.

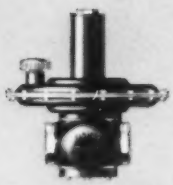
Write Fisher for the information and bulletins that cover the method or combination of safety regulation you prefer.

SAFETY RELIEF VALVES

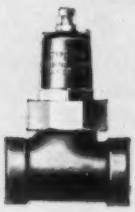
Type 282—6303M Dia-grid for large capacity and tight shut off.



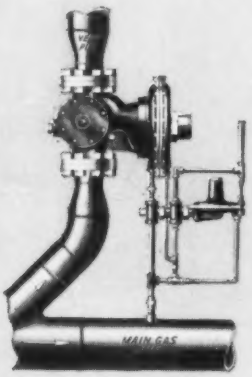
Type 289H Relief Valve available in 1" size for settings up to 20 psi and 2" size for relief pressures up to 10 psi.



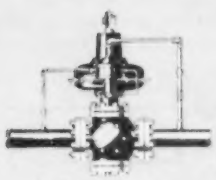
Type 66R Relief Valve used in many industrial applications. Available in sizes 2" through 4".



Type 1805 Small and Compact Relief Valve for farm tap and similar applications.



Type 29 High Capacity, Low Pressure Relief Valve for settings up to 20 psi.



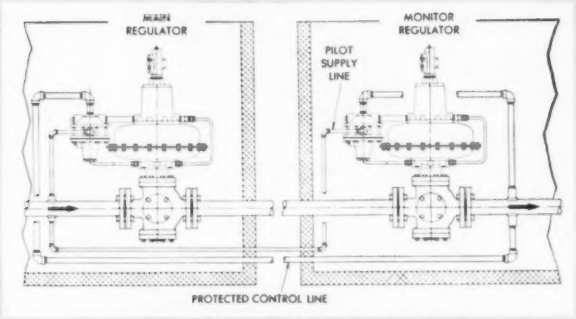
IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...

PROTECTION FOR *ANY* GAS SYSTEM

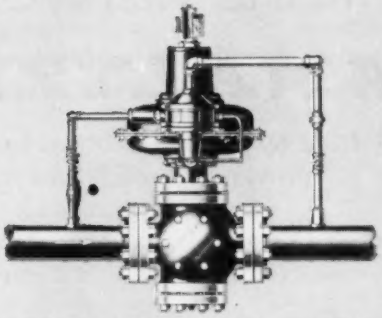
SHUT OFF...OR OVER-RIDE

the *FISHER/MAN* has the answer

2 SAFETY OVER-RIDE REGULATOR

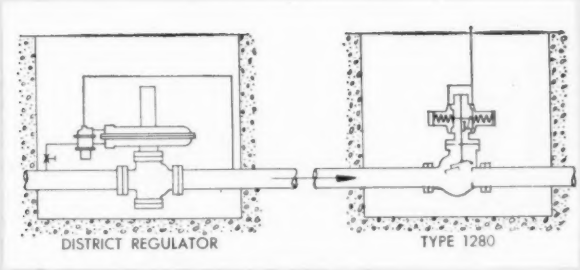


A monitor or over-ride regulator set a little above the district regulator is ready to take over if a stone or other material lodges on seat and keeps main regulator open.

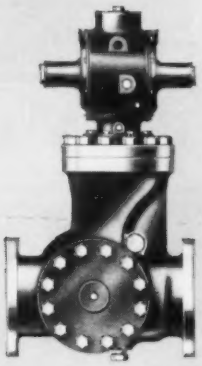


Type 298T-61L pilot operated district regulator used as both the main and monitor regulator is available in a wide range of sizes and loading pressure pilots.

3 SAFETY SHUT OFF



Safety trip-out valve for district regulator stations which will completely shut off the flow to the downstream system should pressure become either excessive or inadequate.



Type 1280 Safety Trip-out Valve is available to shut off with increasing pressure for settings from 14" w.c. to 55 psi and to shut off with falling pressures from 2" w.c. to 55 psi.

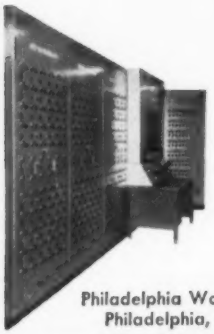
FISHER® Controls

SINCE 1880

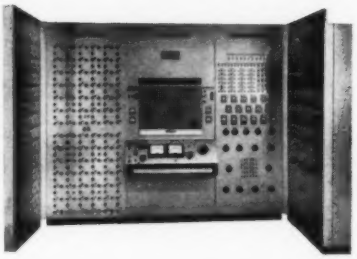
FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT CO., CORAOPOLIS, PENNSYLVANIA



Philadelphia Water Department
Philadelphia, Pennsylvania



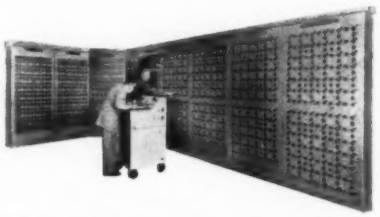
Baltimore County Department of Public Works
Towson, Maryland

McILROY
FLUID NETWORK
ANALYZER

Used by leading utilities to provide up-to-the-minute system analysis and to prove, in advance, plans for expansion and growth.

STANDARD
TRADEMARK

Washington Suburban Sanitary Commission
Hyattsville, Maryland



Public Service Electric and Gas Company
Newark, New Jersey

Southern California Gas Company
Los Angeles, California

Philadelphia Gas Works
Philadelphia, Pennsylvania

For information and a complete list of users of the McIlroy Fluid Network Analyzer, write to The Standard Electric Time Company, 89 Logan Street, Springfield 2, Massachusetts.

THE STANDARD ELECTRIC TIME COMPANY

Springfield, Massachusetts

CAP FORGED STEEL

INSULATING UNION

GREATER SAFETY • FEWER REPLACEMENTS

ENGINEERED—TESTED—PERFORMANCE-PROVED

for gas service

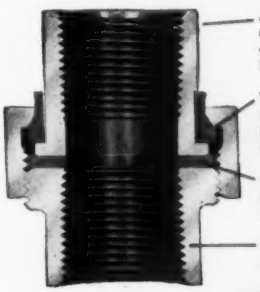
Each year, more corrosion engineers specify CAP Insulating Unions for their meter installations. These are necessary to assure maximum service from pipe and equipment. Insulating unions prevent corrosion caused by electrolysis.

Both the Capitol *Special* and *High Temperature* insulating unions are engineered specifically for gas service—performance-proved by years of service without a single failure—tested for assured quality control.

The *Special* insulating union is recommended for normal applications and will withstand up to 250° F (external heat). The *High Temperature* insulating union will withstand 450° F for one hour (the temperature at which solder in the meter will melt). The *High Temperature* union is designed for maximum protection against a gas leak in the event of a fire.

Only CAP gas service insulating unions have all of these features:

- Forged Steel construction—eliminates danger of sand holes or porosity.
- Exclusive Heavy Tapered Insulation—make connections 3-times stronger than light square type.
- Color Coded—for easy identification by service crews . . . orange for *Special* . . . yellow for *High Temperature*.
- Black oxide coated to prevent rusting.
- Two-thirds insulating unions, *Special* and *High Temperature* are available.


ALL FORGED STEEL for maximum tensile strength—no porosity—no sand holes.
TAPERED INSULATION assures 3-times stronger connections than light square type.
INSULATING is tested and proved effective, long-lasting.
NATIONAL PIPE TAPER for tighter joints.

Add to the life of your company's piping and meters by using CAP Insulating Unions on all installations.

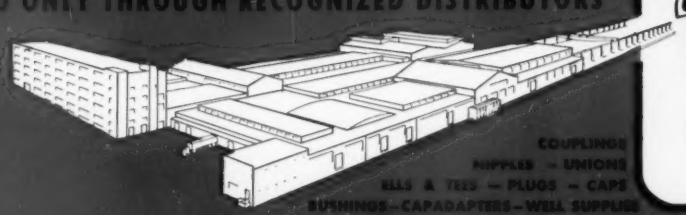
CAP *Special* and *High Temperature* Insulating Unions

Size	Overall Dimensions	Special Part No.	High Temp. Part No.	Quantity in Carton	Approx. wt. per 100
¾″	2.27″	GS-33	GHT-3	20	72#
1″	2.89″	GS-44	GHT-4	12	110#
1¼″	2.96″	GS-55	GHT-5	10	150#
1½″	3.07″	GS-66	GHT-6	5	220#
2″	3.48″	GS-77	GHT-7	5	340#

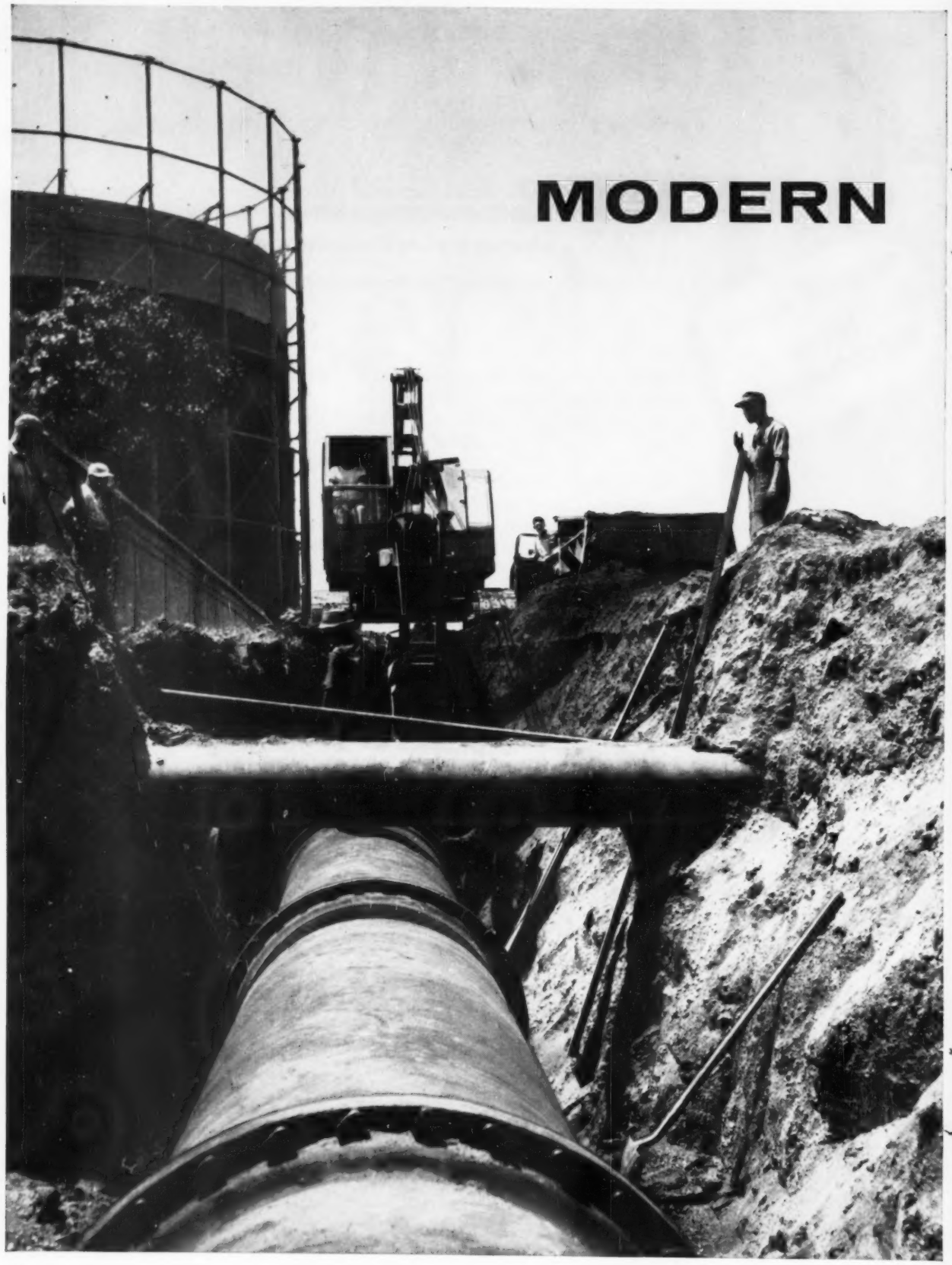
CARTONED:

Packaged in small cartons for easier handling, better protection, save time and reduce inventory losses.

SOLD ONLY THROUGH RECOGNIZED DISTRIBUTORS



CAP CAPITOL MANUFACTURING CO.
DIVISION OF HARSCO CORP.
COLUMBUS, OHIO


MODERN

Proved by over 100 years of service . . .

Engineered to last the next 100 years . . .

CAST IRON PIPE

Only cast iron pipe combines the dependability of a century of underground gas distribution service with the modern features needed by metropolitan utilities today. Specify modern cast iron pipe for your gas distribution mains and be certain of satisfactory performance from that moment on.

Unrivaled record of long life

Laid 123 years ago in Boston, this 6-inch cast iron gas main is in continuous service for the Boston Gas Company. Today 59 gas utilities in the United States and Canada are using cast iron mains installed over a century ago. Cast iron gas mains in service for 30, 40, 50 years or more are common, even in areas with adverse soil conditions. No better proof of corrosion resistance exists in the gas distribution industry!

Modern, improved cast iron pipe

Today's cast iron pipe, centrifugally cast, has a tensile strength over 50% greater than older cast iron mains. Beam strength and load resistance are increased. Bottle-tight mechanical joints successfully withstand vibration, washouts and heavy top loads. Laying and backfilling go faster, and no bulky jointing materials are required.

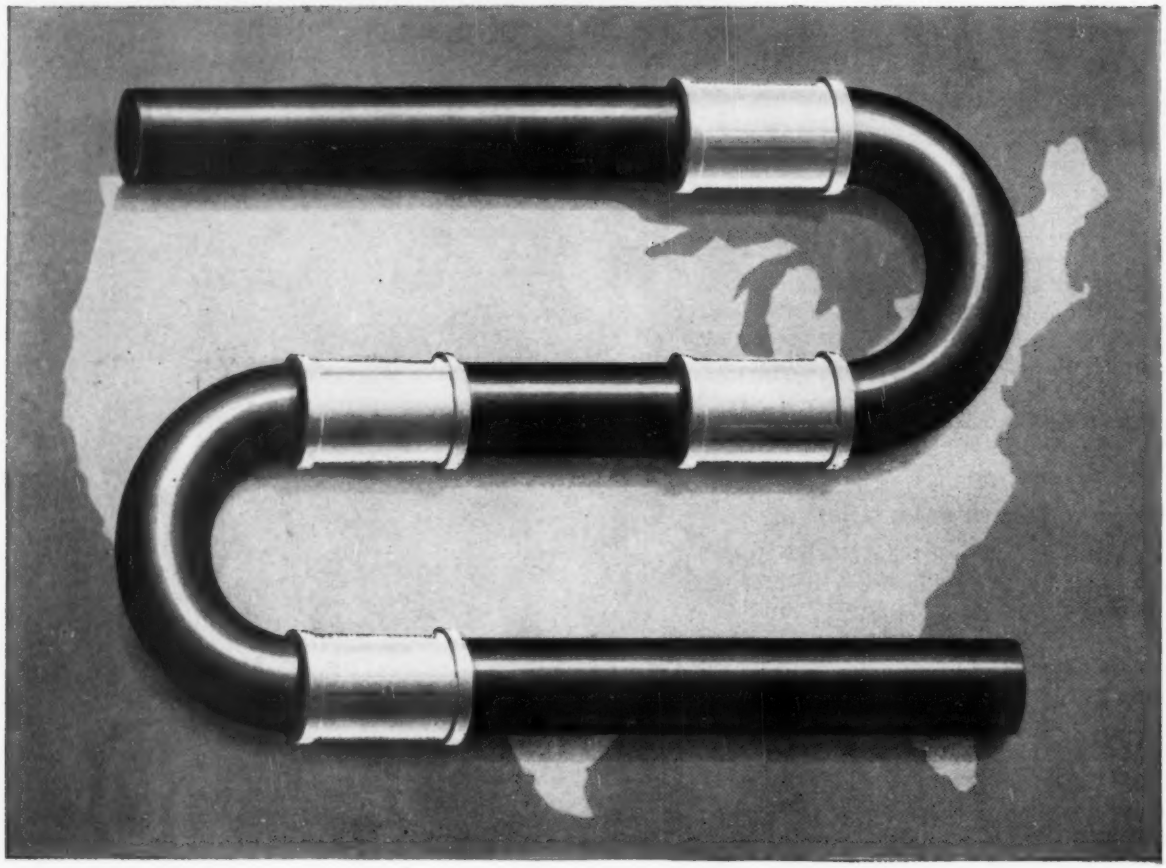
. . . All good reasons for <u>you</u> to choose

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

Write for complete information to Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Ill.

Naugatuck KRALASTIC



9,000 miles of evidence...
KRALASTIC pipe is superior!

Count it by the mile or by the inch, the amount of KRALASTIC® pipe already installed—for everything from drinking water service to salt water disposal, from oil, gas and chemical lines to underground electrical conduit—offers convincing evidence of this superior pipe material's many advantages.

The record of those 9,000 miles of KRALASTIC pipe installed *proves* KRALASTIC's outstanding virtues. Proves the lasting properties of KRALASTIC. Proves the versatility of KRALASTIC. Proves KRALASTIC's extreme ease of installation. Proves its ability to take all kinds of weather, from extremes of Tropic heat to the depth of Arctic cold.

Benefit from the experience of the hundreds of users who have proved the unique advantages of KRALASTIC pipe. Investigate this superior plastic piping material yourself. Write for your free copy of the KRALASTIC story—"9,000 miles of KRALASTIC pipe".

United States Rubber
Naugatuck Chemical Division
814K ELM STREET
NAUGATUCK, CONNECTICUT

KRALASTIC RUBBER-RESINS • **MARVINOL** VINYLS • **VIBRIN** POLYESTERS

Akron · Boston · Gastonia · Chicago · Los Angeles · Memphis · New York · Phila. · CANADA: Naugatuck Chemicals · Elmira, Ont. · Cable: Rubexport, N.Y.

New Ford Industrial Tractor with 12 ft. Backhoe

DIG WITH FORD

You'll Be a One-Man Work Gang!

- Choice of Ford 10 ft., 12 ft., 14 ft. Backhoes.
- Rugged construction, exclusive design for superior performance on any digging job.
- Backhoes use tractor's equipment hydraulic system; quickly attached or detached to free 3-point hitch.
- Clamp-type hitch; no pins or bolts.
- Cushioned seat with back rest; wide open visibility.
- Wide 10′ stabilizer work stance; 77″ transport width.
- Superior reach, digging depth, undercutting, truck loading with all models.
- Many buckets; unmatched capacity.
- Full-power 185° swing.
- No delays, no wandering in swing system.

These of course are only highlight features. See Ford, try Ford at your dealer's, or for detailed specifications write Industrial Tractor and Equipment Department, Ford Motor Company, Birmingham, Michigan.

Ford Motor Company

PRINTED IN U. S. A.

New Ford Industrial Tractor with Super-Duty Loader

LOAD WITH FORD *You'll Be a One-Man Work Gang!*

- Full length load-carrier frame.
- 7000 lb. capacity "H" beam front axle assembly.
- 11,000 lb. capacity grille-bumper.
- 172 cu. in. "Red Tiger" engines, gasoline or diesel.
- Choice of transmissions including "Select-O-Speed."
- Full hydraulic power steering.
- "Third hand" foot throttle.
- Tire and wheel options for every job.
- Loader uses equipment hydraulic system; 3-point hitch system free for other attachments.
- 3/8, 3/4 and 1 cu. yd. tread width buckets.
- 2500 lb. lift capacity; 5500 lb. breakaway.
- Cushioned seat with back rest; wide open visibility.
- Exclusive bucket position indicator.

Ford Motor Company

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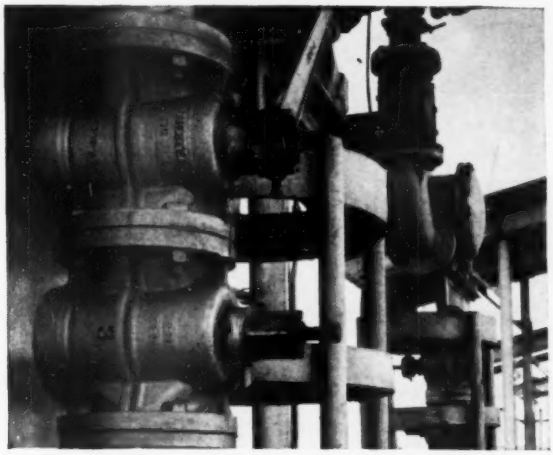
Homestead Plug Valves Help to Keep Aviation Gas Pure at Naval Air Base, Norfolk



3" Homestead Lubricated Plug Valves handling gasoline on tank truck loading docks at Naval Air Station, Norfolk

Aviation gasoline must be kept free of contamination. That's why fuel lines on truck or ship loading docks, and on underground storage tanks, are so often controlled by Homestead Lubricated Plug Valves.

Controlled pressurized lubrication system and extremely close tolerance between plug and body, prevent lubricant from being extruded into line—prevent contamination of gasoline. Add Homestead's reinforced Teflon* head seal and double ball check valve, and you have a truly dependable plug valve—one that opens quickly and fully for fast loading; closes quickly and tightly for positive fluid control.

Mail coupon today for Reference Books 39-1 and 1A, your complete library on Homestead Lubricated Plug Valves.

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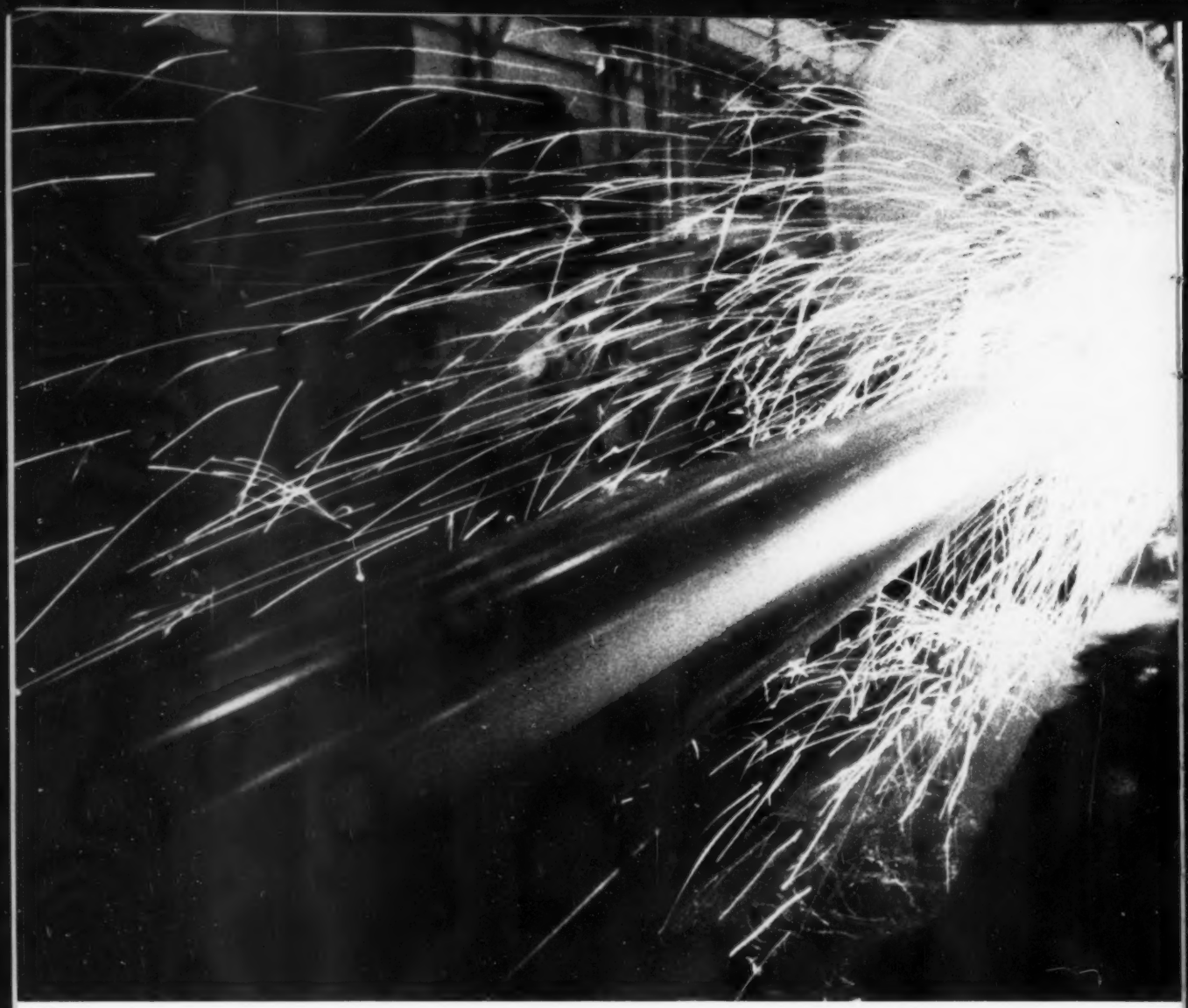
HOMESTEAD VALVE MANUFACTURING COMPANY

Box 405, Coraopolis, Pennsylvania



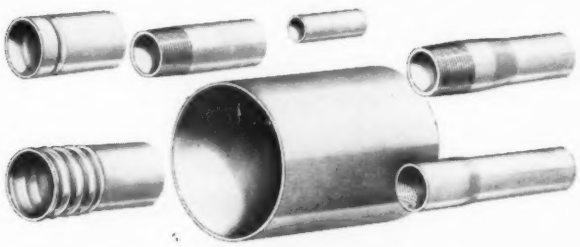
TEX-TUBE Teamwork

Walk through Tex-Tube's modern pipe mill in Houston and you'll see teamwork in action.

You'll witness the painstaking care that goes into manufacturing the world's finest lightwall pipe; the quality control—from selection of skelp to electric resistance welding to hydrostatic testing to final inspection.

Tex-Tube Lightwall Pipe and other quality products are stocked at six strategic locations for fast delivery to your jobsite. Close teamwork between Tex-Tube's mill, sales-service and distribution facilities means a dependable supply of these quality tubular goods available to you at all times. Count on Tex-Tube.

helps you



TEX-TUBE, INC.

1503 NORTH POST OAK ROAD • HOUSTON, TEXAS

Sales Offices in Midland, Texas—Tulsa, Oklahoma—
Dallas, Texas—Los Angeles, California

For the toughest assignments . . .

AMERICAN Ductile Iron PIPE

withstands heavy external loading and impact

Under heavy external and extreme shock loads imposed by the pounding of modern highway traffic . . . under deep cover or on unstable bedding . . . American Ductile Iron Pipe has the strength and toughness to withstand tough treatment.

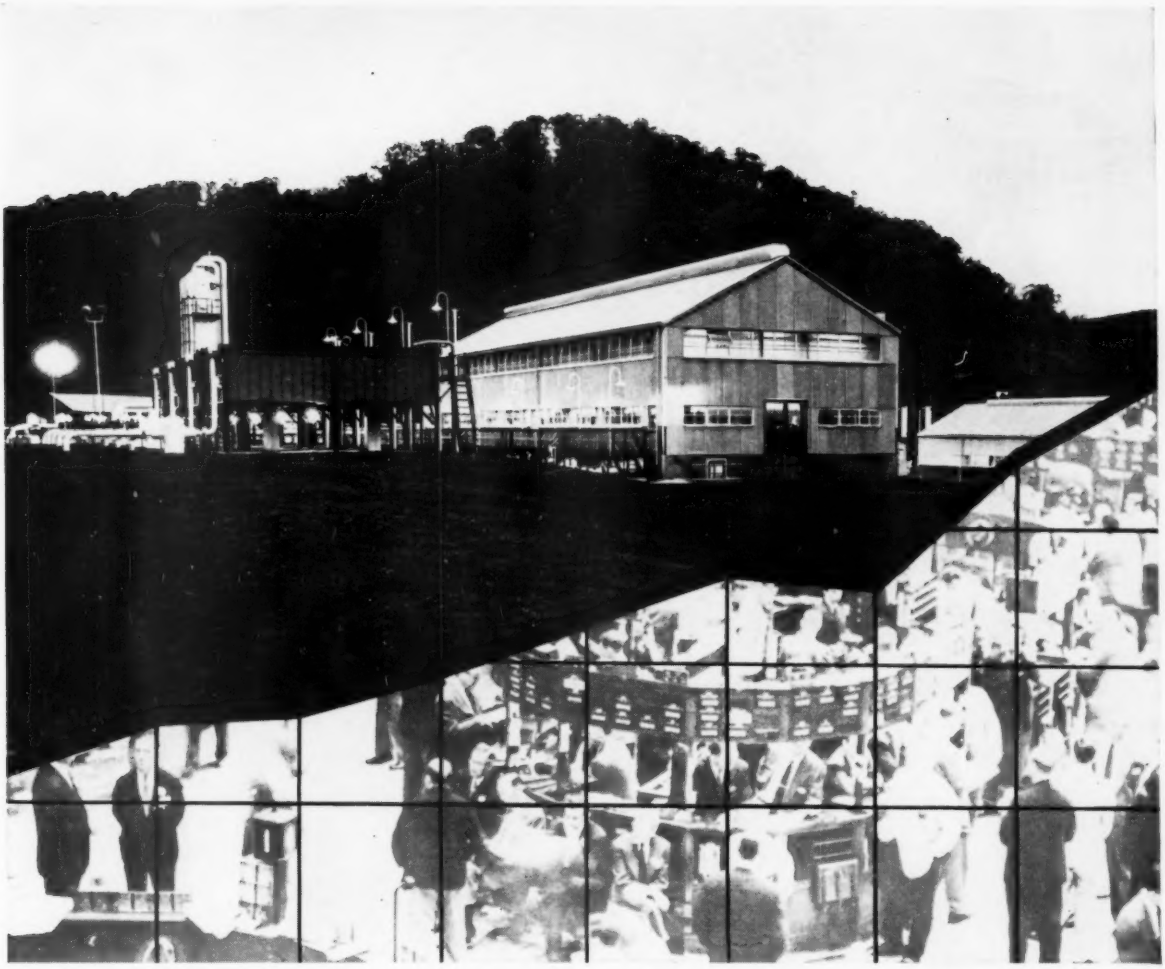
This new development in piping material combines the most desirable physical properties of both steel and gray cast iron. American Ductile Iron Pipe has high strength, actually bends under stress like steel, but has the age-old corrosion resistance of gray cast iron. It's tough enough to withstand any shock . . . in shipment, in installation, in service. It meets the super-service requirements of modern gas distribution and provides extra factors of safety, as well.

Put this new super-service material in your plans for the tough assignments. Detailed information is available from your nearby American Cast Iron Pipe Company representative.

GEM

AMERICAN CAST IRON PIPE CO.
BIRMINGHAM ALABAMA

SALES OFFICES
New York City • Dallas
Chicago • Kansas City
San Francisco • Denver
Pittsburgh • Orlando
Minneapolis • Cleveland
Birmingham



Compressor station squeezes gas handling costs through Pritchard's GOOD FINANCIAL DESIGN

The Majorsville Compressor Station recently built by J. F. Pritchard & Co. is part of a double-barreled solution to the problem of meeting peak demands for gas in the Pittsburgh area. Manufacturer's Light and Heat Company uses the new 5280 HP station in two ways: 1) to make the most economical use of pipeline capacity and 2) to reduce storage costs.

During off-peak periods, the station injects pipeline gas into depleted West Virginia gas wells which now serve as underground storage tanks. In this way, the company is able to take full advantage of off-peak rates. In the winter, the station withdraws the stock-piled gas and pumps it to customers.

Through Pritchard's emphasis on good financial design, the Majorsville Station has replaced an older compressor station at a cost permitting a reasonable return on the investment.

Compressor stations have long been a Pritchard specialty. In the last two years, Pritchard has installed over 130,000 HP on some 28 different jobs. On many of these installations, Pritchard did the entire job—design, engineering and construction. Other Pritchard services for the gas industry include dehydration plants, gas conditioning and treating plants, LP gas storage systems and peak shaving plants.

Pritchard's know-how and experience . . . Pritchard's emphasis on good financial design . . . are at your service.

Regardless of the size of your next job—if it's in the gas industry—it will pay you to talk to Pritchard.

PROFITABLE FACILITIES THROUGH GOOD FINANCIAL DESIGN

J.F. **Pritchard** & Co.

ENGINEERS • CONSTRUCTORS

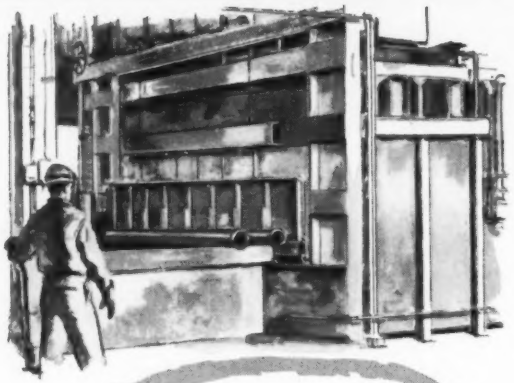
Dept. 414, 4625 Roanoke Parkway, Kansas City 12, Mo.

OFFICES IN CHICAGO, HOUSTON, PITTSBURGH, NEW YORK

SERVING THE GAS, POWER, PETROLEUM AND CHEMICAL INDUSTRIES

THE BLACKSMITH . . . legendary figure of other days, heated his metals in a crudely built forge.

BASIC...but better than ever today



TODAY . . . dependable gas supplies heat for thermostatically controlled heat treating furnaces such as used for our cast iron pipe.

Cast iron pipe's reputation for long life was won the hard way—by proved performance in the field.

Throughout the country today many cast iron gas mains, a century and more old, are still serving.

This outstanding record is the result of cast iron's inherent quality. Quality that we, for one, maintain at maximum levels by supervising every production step from mine to finished product.

You can depend on U. S. Pipe. It is quality-controlled in manufacture to insure top performance in the main.

SERVICE IS BUILT INTO CAST IRON

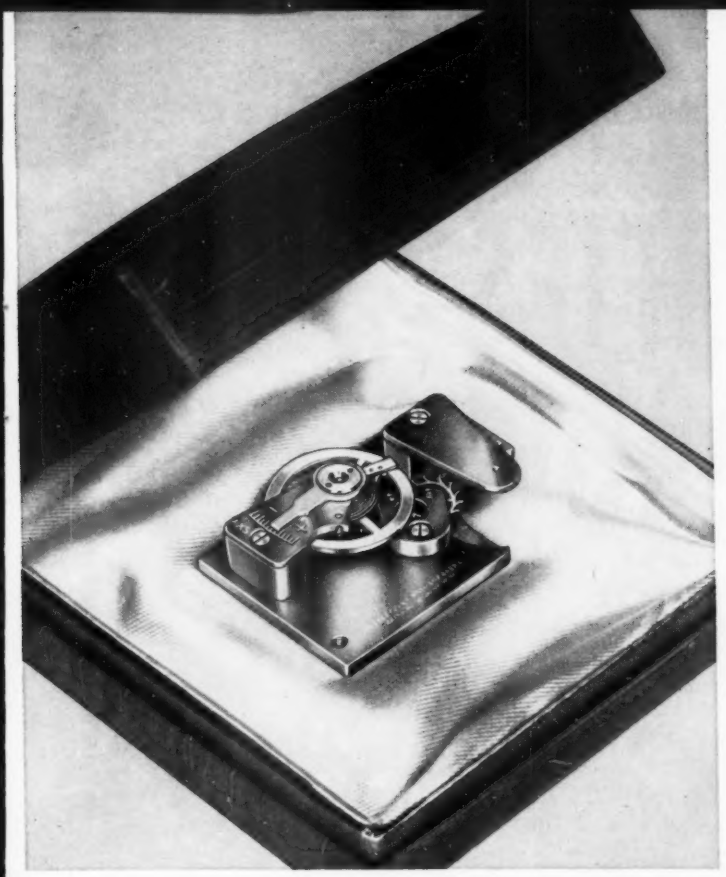
- Standardized mechanical joints are bottle-tight for usual gas distribution pressures . . . and for all types of gas.
- Centrifugally cast pipe is tough, strong and uniform.
- Joint design allows for deflection during and after installation.
- Service connections are easily made
- Long life a matter of record.
- No shortages. Cast Iron Pipe is immediately available.

U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

U.S. cast iron PIPE
CAST IRON

GEM



Now there's a New "Jeweled" Escapement in ROCKWELL CHART DRIVES

for greater accuracy and longer life

This jeweled movement brings fine watch quality to instrument timing

SPEED CHANGING TURRETS PROVIDE SEVEN DIFFERENT ROTATION RATES

The basic Rockwell Chart Drive has a main arbor rotation rate of 7 days. Economical snap-on turrets permit changing to 8-day, 15-day, 16-day, 24-day, 30-day, 31-day, and 24-hour rotation. No tools or special skills are required. You can even change chart rotation without removing the drive from the instrument.

The introduction of a jeweled movement—the first ever used on a general industrial timing device made in the United States—makes the Rockwell more accurate than any unjeweled chart drive could possibly be. In addition to offering fine watch quality, the jeweled escapement requires less power to operate and is extremely durable, since seven hard jewel surfaces are provided to limit friction and wear.

You will benefit in many ways by using these jeweled movement chart drives for powering all your recording instruments. They adapt readily to fit into practically any instrument case while speed-changing turrets (see left) permit changing rotation rates at will. Write for full information. Rockwell Manufacturing Company, Instrument Division, Pittsburgh 8, Pa.

JEWELED CHART DRIVES

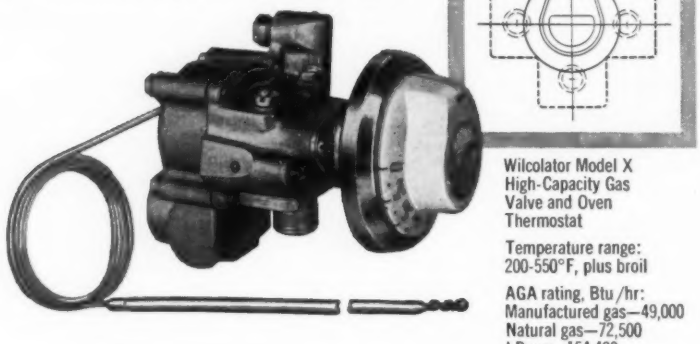
another fine product by

ROCKWELL

NEW WILCOLATOR **MODEL X** CONTROL

SIMPLIFIES OVEN HOOK-UP

4-way outlet casting eliminates special fittings



Wilcolator Model X
High-Capacity Gas
Valve and Oven
Thermostat

Temperature range:
200-550°F, plus broil

AGA rating, Btu/hr:
Manufactured gas—49,000
Natural gas—72,500
LP gas—154,400

In the Wilcolator Model X control, the outlet casting can be located in any one of the four positions shown and can also be tapped at sides or bottom. These options help simplify oven hookup, eliminate need for adapters or special fittings, save assembly time and labor cost. For complete information on all the advantages of this new high-capacity gas valve and oven thermostat, request Bulletin 547 (for ranges with automatic oven ignition, Bulletin 548—Model XC).

Thermostats for Every Heating and Cooling Application

THE WILCOLATOR COMPANY
1001 NEWARK AVE., ELIZABETH, N. J.
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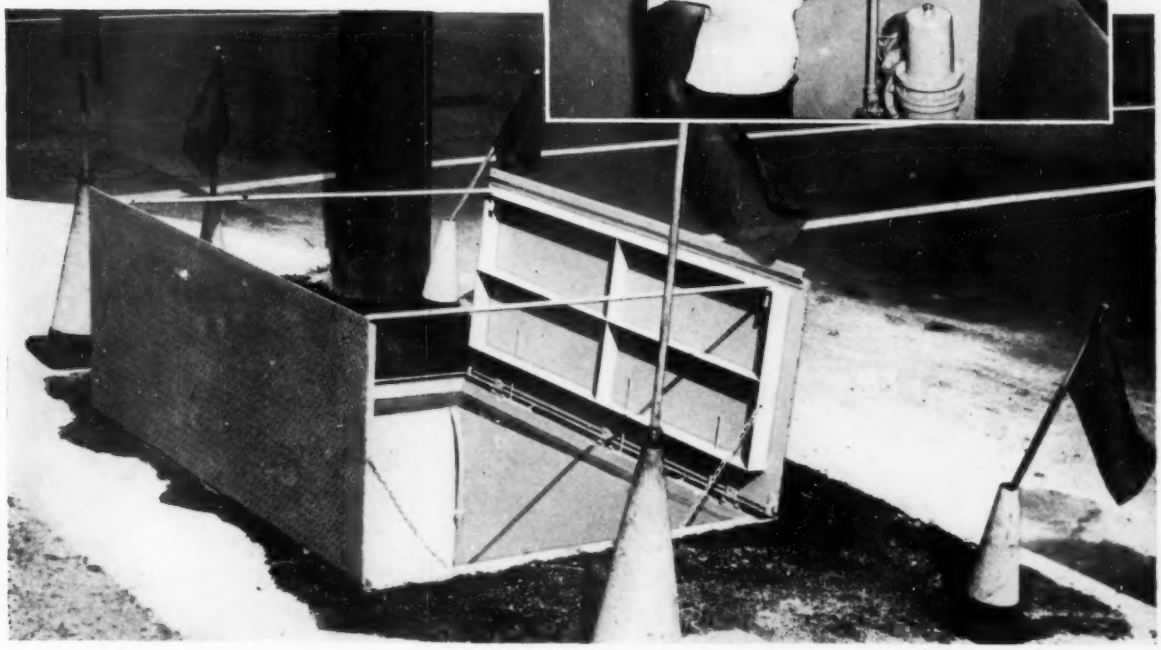

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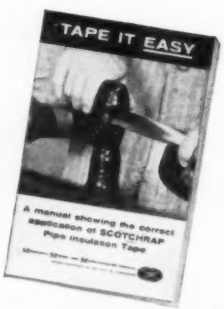

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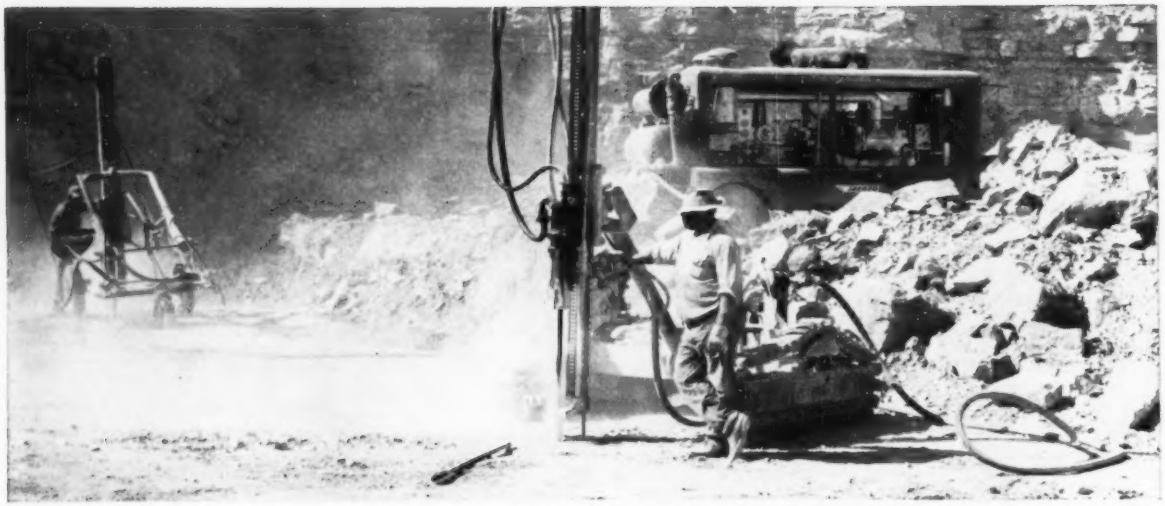

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GAS

AUGUST 1959

Remote control of a small booster station

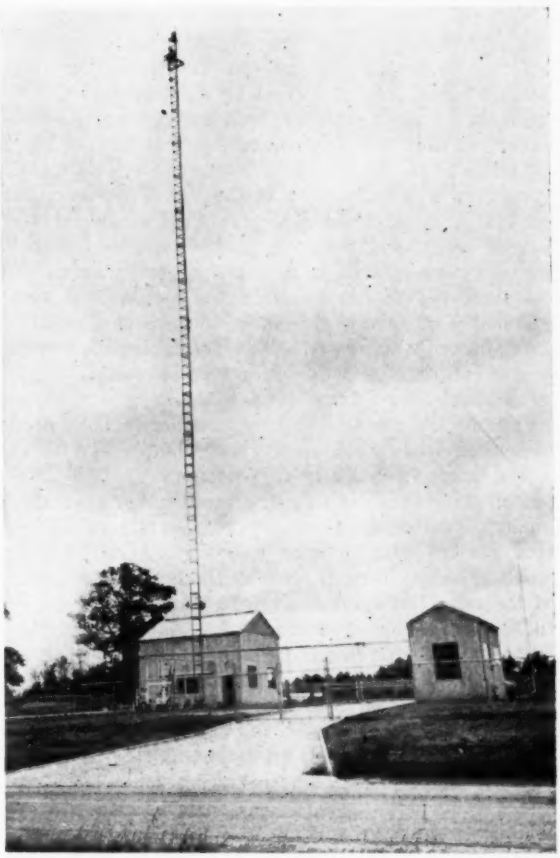
By P. A. RAY, Vice President and Chief Engineer
United Cities Gas Co., Chicago

GAS exclusive

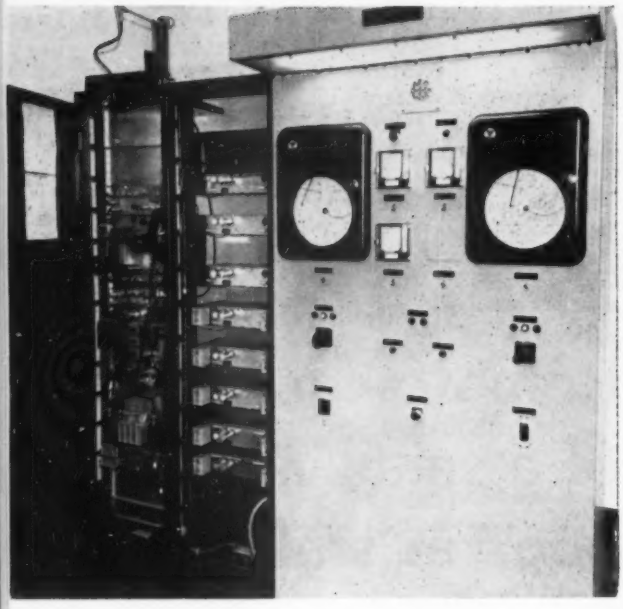
ONE of the first, if not the first, automatic unattended natural gas compressor stations of the reciprocating type was placed in operation in January 1958. This station was designed and constructed in 1957 by United Cities Gas Co. for its Georgia Gas Co. division at Gainesville, Ga. It is located near the mid-point of a 31-mile transmission line supplying the gas requirements in Gainesville. Natural gas is purchased from Transcontinental Gas Pipeline Corp. at a tap on its line near Bogart, Ga.

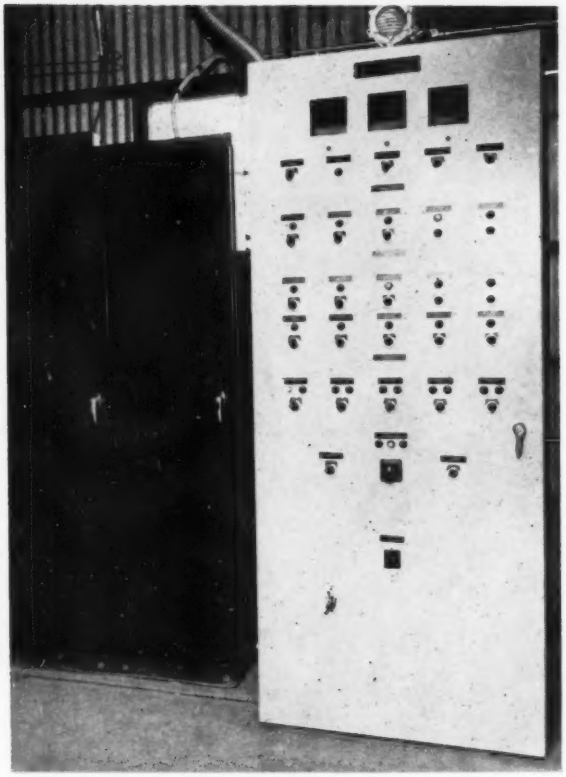
This compressor station is possibly unique in the application of complete remote control to a single compressor unit which operates intermittently. In fact, it will be used for the few coldest days of the year, and during at least the early years it will be operated for only a portion of such coldest day.

The 31-mile transmission line was constructed in 1952 with the knowledge that within five years that line would not be capable of supplying the gas requirements for the customers in Gainesville. The development of gas use in Gainesville exceeded expectations. In 1956 it became apparent that, should a maximum degree day deficiency be experienced during the 1957-58 heating season, the pipeline capacity would not be sufficient to meet the requirement.



Microwave is the means of communication between the controlling point in Gainesville (above left) and the compressor station, 15 miles away (bottom). Radio control equipment is in the smaller building; engine compressor is in larger building.





Microwaved signals originate at the Nelex board (above) in Gainesville and are transmitted to the station panel (right). Cabinets next to panel contain radio equipment, including radio phones. Lights and gauges on board give essential operating information. The two recording charts on the Gainesville board give a record of the pressure and volume of gas flow.

Careful analysis of the problem indicated that any construction to provide additional capacity should be capable of increasing existing capacity by at least 50 per cent. Engineering studies then determined that it would be necessary to loop at least 20 miles of the 31-mile pipeline to achieve that goal. Attention was then given to the use of compression to obtain the desired capacity. Cost estimates disclosed that the increased capacity could be obtained by compression with an investment of approximately 70 per cent of that required for looping the line. Estimates of future growth in the gas service area in Gainesville indicated that in all probability both a combination of looping and compression would ultimately be required to handle the gas requirements of this rapidly growing community. The decision then was to construct a compressor station as a first stage in ultimate development.

Following this decision, the problems of operating such a station were considered. As stated above, this station will be used only during the coldest weather in the heating season. During the first year of its use, such operation might total as little as 10 to 15 days, growing through the years to possibly 60 days. It therefore did not appear logical to permanently assign company personnel to operations at the compressor station site. The next approach was to have operating personnel travel the approximately 25 road miles to the station each day on which its use might be required. However, serious weather conditions, in the form of sleet storms which periodically appear in this section of north Georgia, would not allow completely dependable operation. The best solution was to construct a remotely controlled station without attendants of any kind, not even a grounds maintenance man. The station is visited periodically to determine that all facilities are in order. During the heating season when operation may be required any time, it is checked once a week, and once a month during the balance of the year.

Microwave radio was selected as the means of communication between the controlling point (located at the offices of Georgia Gas in Gainesville) and the compressor station. Here again, the possibility of serious sleet storms precluded the use of long lines as the means of communication. The science of microwave radio has advanced to the extent that it is considered to be over 99 per cent dependable.

Since this was to be one of the first reciprocating-type compressor stations to use full remote control, its design and construction presented many problems as to which functions should be subject to remote control. The control system required to start and stop the gas-fired engine presented no serious problem. The three categories which did require careful study were:

1. Placing the compressor station "on the line" and taking it "off the line";
2. Those functions requiring warning and/or emergency shutdown controls to provide safety and protection essential to station operation;

3. Essential operating data to be transmitted to the remote controlling point.

The investment to be made was an important item in these considerations. If non-essentials were included, the resulting investment would be excessive.

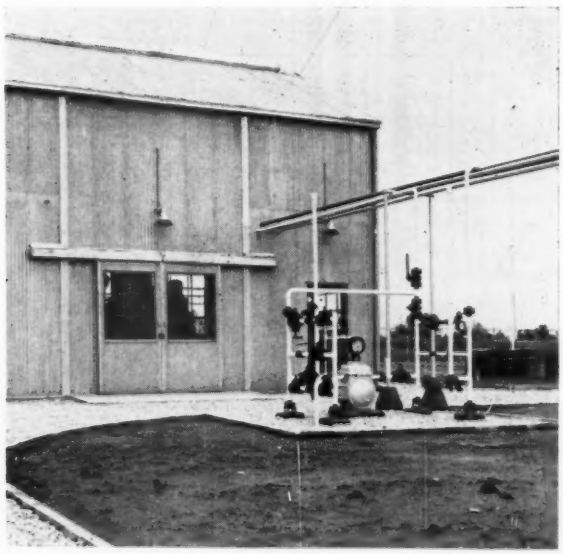
The gas-engine-operated compressor unit is an Ingersoll-Rand No. 8-SVG rated at 440 bhp at 400 rpm. This unit, with all controlling devices associated directly with it, was manufactured and tested by Ingersoll-Rand at its plant in Painted Post, N. Y.

The unit then was shipped to the Stearns-Roger Manufacturing Co. in Denver, Colo. There it was mounted on a substantial skid base with all essential auxiliaries such as the water and oil cooling equipment, oil filtering equipment, and instruments to be located at the compressor unit for purposes of speed control, proper loading and unloading of the compressor cylinders, etc. This skid-mounted unit with auxiliaries was then shipped to the compressor station site in Georgia and installed on the footings and foundations constructed for this purpose.

Radio Corp. of America furnished and installed the microwave radio equipment and the supervisory control and telemetering equipment at both the station and the remote controlling location. The control consoles with full equipment as designed were manufactured under sub-contract by Nelson Electric Co. of Tulsa, Okla. All installations and construction other than that provided by RCA at the compressor station site were performed directly by United Cities Gas Co.

To assist in the design and to coordinate the construction, a meeting of the representatives of all contractors and sub-contractors was held at the Chicago office of United Cities. This meeting also assisted in the final selection of those functions which were to be incorporated in the station design.

An elapsed-time bargraph has been prepared to illustrate the unit starting sequence, including placing the unit on the line.



Metering station in front of compressor building.

Unit operating selector switches are provided at both the station and the remote control location. Three selections are provided: "start," "stop," and "off." In normal operation the start position serves to start the engine, prepare it for actual use, and place the compressor unit on the line; the stop position serves to take the unit off the line, operate the engine for a short cool-off period, and finally shut down the engine. The off position is used for emergency or abnormal operating conditions. Whenever the unit must be shut down during a starting sequence before that sequence is completed or the unit fully placed on the line, or in the event that an emergency shutdown occurs through malfunction of the compressor station, the selector switch must first be set to the off position before again initiating a start sequence.

When a starting sequence is initiated, auxiliary pumps are operated for four minutes to circulate crankcase oil through the engine and to operate the force-feed lubricator to assure proper lubrication for the compressor rod packing and compressor cylinders. These units are driven by air motors using natural gas from the transmission line as the power medium. As the station may be shut down for a week or longer, it is most essential to assure that all bearings and cylinder or rod packing services are properly supplied with lubricant before the engine is cranked and placed in operation.

The building housing the engine compressor unit is not heated. It was therefore essential to devise some means of maintaining the temperature of the crankcase oil above a minimum of 45 deg during the period that the unit is idle. A thermostatically controlled 5-kw Calrod electric heater is inserted in the crankcase for this purpose. This assures proper precirculation of oil and ample cranking speed to fire the engine. Once the engine has fired, the thermostat is temporarily bypassed and the Calrod unit energized to assist in and shorten the engine warm-up period.

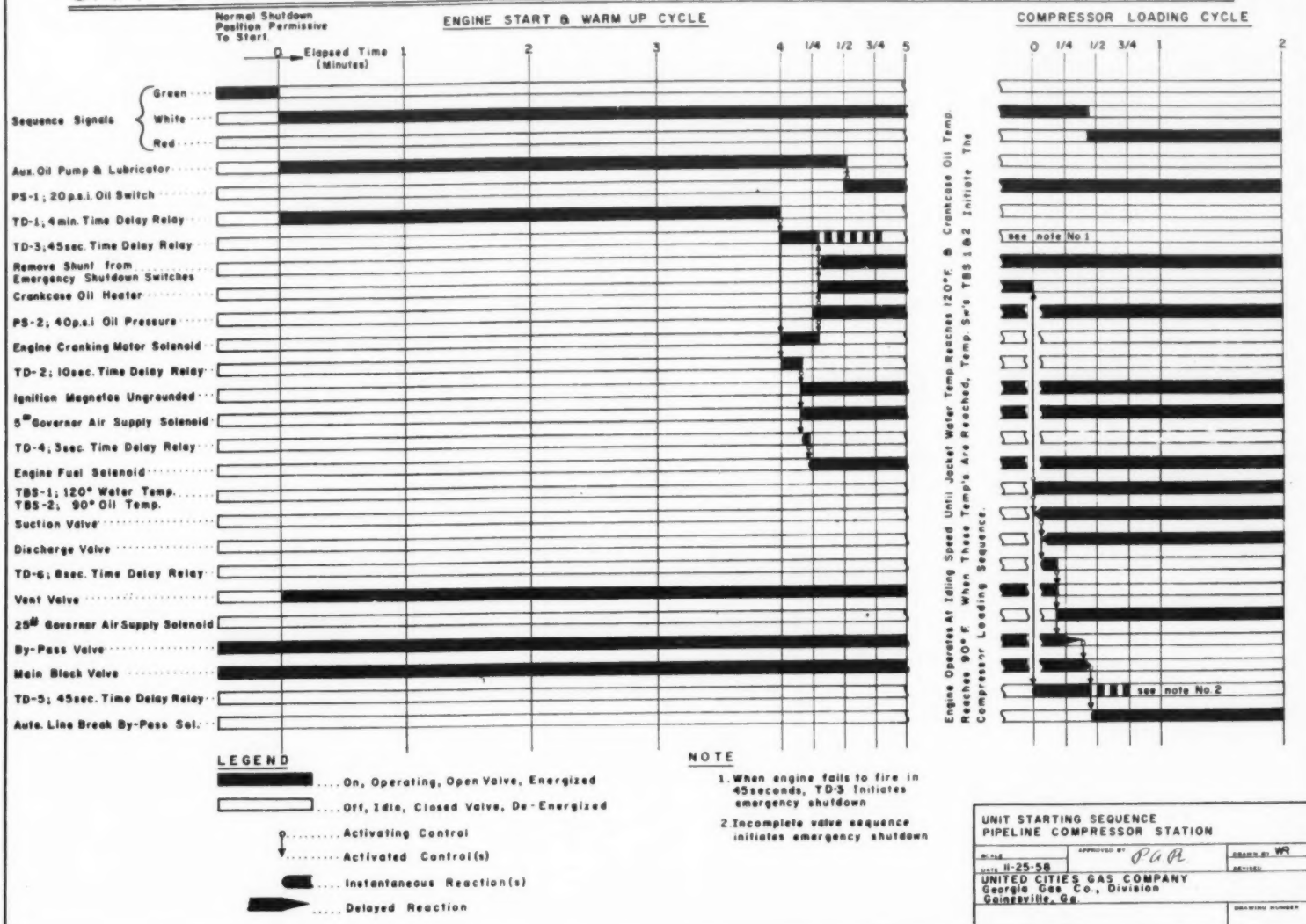
After the auxiliary pumps have operated for four minutes, the engine cranking sequence is initiated. An Ingersoll-Rand air motor, equipped with a Bendix drive installed with a gear train on the engine flywheel, is used to crank the engine. Natural gas at pressures of 125 lb is supplied directly from the transmission line to operate the cranking air motor. This eliminates any dependence upon a supply of compressed air for cranking the motor.

The engine is cranked for 10 seconds to properly purge the engine cylinders and the ignition magnetos are then ungrounded. Three seconds later the engine fuel solenoid valve is energized. The engine fuel line vent valve is also closed by solenoid action.

At the same time engine cranking is initiated, a 45-second time-delay relay is energized. If the engine does not catch fire and operate at a minimum speed setting within these 45 seconds, the relay times out and an emergency shutdown sequence is initiated to stop the starting and loading sequence

Elapsed-time bar graph

UNIT STARTING SEQUENCE PIPELINE COMPRESSOR STATION


Normal Shutdown Position Permissive To Start.
ENGINE START & WARM UP CYCLE
COMPRESSOR LOADING CYCLE
0 Elapsed Time (Minutes) 1 2 3 4 1/4 1/2 3/4 5
0 1/4 1/2 3/4 1 2
Sequence Signals
Green
White
Red
Aux. Oil Pump & Lubricator
PS-1; 20 p.s.i. Oil Switch
TD-1; 4 min. Time Delay Relay
TD-3; 45 sec. Time Delay Relay
Remove Shunt from Emergency Shutdown Switches
Crankcase Oil Heater
PS-2; 40 p.s.i Oil Pressure
Engine Cranking Motor Solenoid
TD-2; 10 sec. Time Delay Relay
Ignition Magnetos Ungrounded
5# Governor Air Supply Solenoid
TD-4; 3 sec. Time Delay Relay
Engine Fuel Solenoid
TBS-1; 120° Water Temp.
TBS-2; 90° Oil Temp.
Suction Valve
Discharge Valve
TD-6; 8 sec. Time Delay Relay
Vent Valve
25# Governor Air Supply Solenoid
By-Pass Valve
Main Block Valve
TD-5; 45 sec. Time Delay Relay
Auto. Line Break By-Pass Sol.
see note No. 1
see note No. 2
Engine Operates At Idling Speed Until Jacket Water Temp Reaches 120°F. & Crankcase Oil Temp Reaches 90°F When These Temp's Are Reached, Temp. Sw's TBS 1 & 2 Initiate The Compressor Loading Sequence.

LEGEND

- On, Operating, Open Valve, Energized
- Off, Idle, Closed Valve, De-Energized
- Activating Control
- Activated Control(s)
- Instantaneous Reaction(s)
- Delayed Reaction

NOTE

1. When engine fails to fire in 45 seconds, TD-3 Initiates emergency shutdown
2. Incomplete valve sequence initiates emergency shutdown

UNIT STARTING SEQUENCE
PIPELINE COMPRESSOR STATION

SCALE — APPROVED BY PAR — DRAWN BY WR

DATE 11-25-58 — REVISED

UNITED CITIES GAS COMPANY
Georgia Gas Co., Division
Gainesville, Ga.

DRAWING NUMBER

and to signal the controlling point that an emergency shutdown has occurred. If the engine fires and reaches minimum speed within the 45-second time, the engine oil pressure will reach and exceed 40 lb, and an oil pressure switch is activated to remove the emergency shutdown time-delay relay from the circuit.

With the engine fired and running, minimum instrument air pressure is applied to the engine governor to operate the engine at a minimum set speed during the engine warmup cycle. The engine then operates for whatever time necessary to bring the cooling water temperature to 120 deg and the engine oil temperature to 90 deg. When these two temperature limits have been reached, the unit is ready to be put on the line and the loading sequence is initiated.

Compressor loading sequence is accomplished in two stages. The first stage consists of station valve operations to connect the compressor unit to the pipeline and the second stage is to block the pipeline between the connections to the suction and discharge headers. Proper sequence in each of these stages received careful study in the station design.

The first stage of the loading sequence is accomplished in three steps: (1) purging the compressor piping; (2) connecting compressor to suction and discharge headers; and (3) closing compressor bypass valve. Actual sequence, as among these steps, is combined in the operation of four valves.

The compressor suction, discharge and bypass valves are Nordstrom lubricated plug valves equipped with Shafer valve operators and controls. Natural gas at full pressure from the suction side of the transmission line is used as the power medium for these operators. Each operator is equipped with limit switches activated in the open or closed position. The compressor piping vent valve is a Garritson combination safety relief and blowdown valve. The venting and purging functions of this valve are initiated by energizing a solenoid valve.

The suction valve is first opened and the compressor piping and cylinders are purged through the vent valve which has been in the open position since the original unit starting sequence was initiated. When the suction valve is fully opened (which is almost instantaneous), an eight-second time-delay relay is energized and, when timed out, the vent valve is closed, completing the purging cycle. Limit switches installed on the suction valve operator close when the suction valve is fully closed, initiating the opening of the discharge valve and closing the compressor bypass valve. Opening of the discharge valve is timed so that the discharge valve is fully opened approximately three seconds before the station vent valve is closed. This assures complete purging of the piping on the discharge side of the compressor. The controls for the bypass valve operator include a timing device which is set so that approximately 11 seconds are required to fully close that valve.

The second stage in the loading sequence is the closing of the valve installed in the transmission line between the connection of the suction and discharge headers to that line. Closing action of this valve is initiated by a limit switch activated when the compressor bypass is fully closed. This stage and the valve control are covered in detail in this discussion as its function is fundamental to continuous operation of the transmission line.

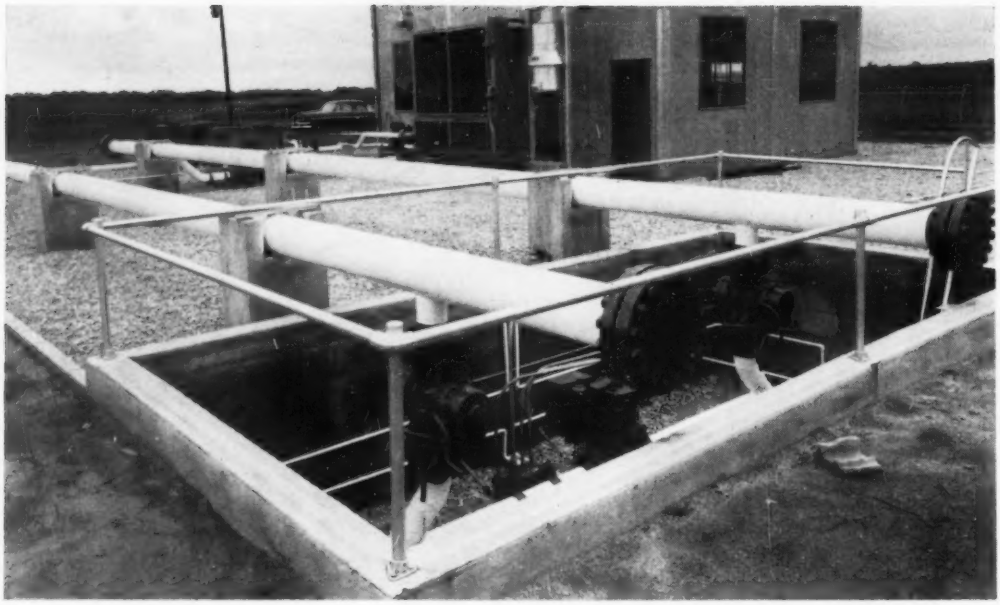
The main block valve is also a Nordstrom lubricated plug valve equipped with a Shafer valve operator and control. The control system is essentially similar to that provided for the other operators but with the addition of a differential control. This differential control serves to initiate the opening cycle of this valve.

The operation of the main block valve is so controlled that the transmission line will function at all times and under all conditions. The closing of this valve is part of the compressor loading sequence and is accomplished in the same manner as the other station valves. The opening cycle is separately controlled and is independent of the station control system. The control is entirely mechanical, without any use of electrical control. A differential diaphragm type controller is connected to the transmission line upstream and downstream of the valve. This controller overrides all other controls and functions to open the main block valve whenever the pressure on the upstream side is greater than on the downstream side. Gas pressure from the transmission line upstream of the valve is used as the power medium for the valve operator. Through this control scheme, continuity in transmission of gas will never fail due to the main block valve remaining in the closed position when the station is not in operation.

The compressor loading sequence control system includes an emergency shutdown control to protect the station against improper or incomplete sequence. When the loading sequence is initiated, a time-delay relay is energized. If this relay times out before the loading sequence (including closing the main block valve) is completed, the station operation will be shut down.

At the same time that the compressor loading cycle is initiated, instrument air pressure of 25 lb is supplied, through a controller, to the engine governor to accelerate the engine to full speed.

With the compressor unit on the line under load, its operation is automatically controlled by devices installed at the compressor to maintain as nearly as possible a constant maximum horsepower use under the full range of operating conditions. Engine speed is controlled as a function of discharge pressure, utilizing a Foxboro controller for this purpose. This controller is adjustable for whatever maximum discharge pressure is desired. Normally, it will be set for a maximum discharge pressure of 550 lb. Engine speed varies from a maximum of 400 rpm to a minimum of 200 rpm. One end each of two of the four double-action compressor cylinders is equipped with loading-unloading devices. These devices are controlled to increase or decrease the compression capacity as a function of the suction pressure. Four Fisher pressure controllers are provided to load or unload the compressor cylinders



An air-operated block valve operates on the 4-in. line shown in the pit (above). When booster compressor is operated, this valve is closed and the gas is routed into the station for compression, then back out and into the line on the downstream side of the valve. The photo on the facing page shows the Smithco heat exchanger. To the right of the cooler are the filter on the air-intake to the compressor engine and the silencer on the engine's exhaust Shafer-operated Nordstrom valves on the yard piping are in the foreground.

equipped with these devices through the suction pressure range from 100 lb to 450 lb.

The compressor unloading cycle is substantially in reverse of the loading cycle. The suction valve is first closed, which in turn initiates the opening of the bypass valve. When the bypass valve is fully opened, the discharge valve is closed. All three valve operations are very rapid, requiring altogether about three seconds. At the same time, governor air pressure is reduced from 25 lb to a minimum pressure of approximately 5 lb, causing the engine to operate at minimum speed. After a five-minute engine cooling period, the engine fuel solenoid is deenergized, and the ignition magnetos are grounded to shut down the engine. At the same time the station vent valve is opened for a period of one minute, venting all pressure from the compressor piping and cylinders.

Throughout the unloading and shutdown cycle, the main block valve remains in the closed position. This valve will continue in the closed position until the transmission line suction and discharge pressures have become equalized and the pressure on the suction side exceeds that on the discharge side by approximately 5 lb. At that point the differential control mounted at the valve operator will function independently to fully open the main block valve.

The engine compressor unit is protected against malfunction by a number of controls, some of which will initiate a warning signal or, in the event any malfunction becomes so serious that a hazardous condition might exist, will initiate an emergency shutdown.

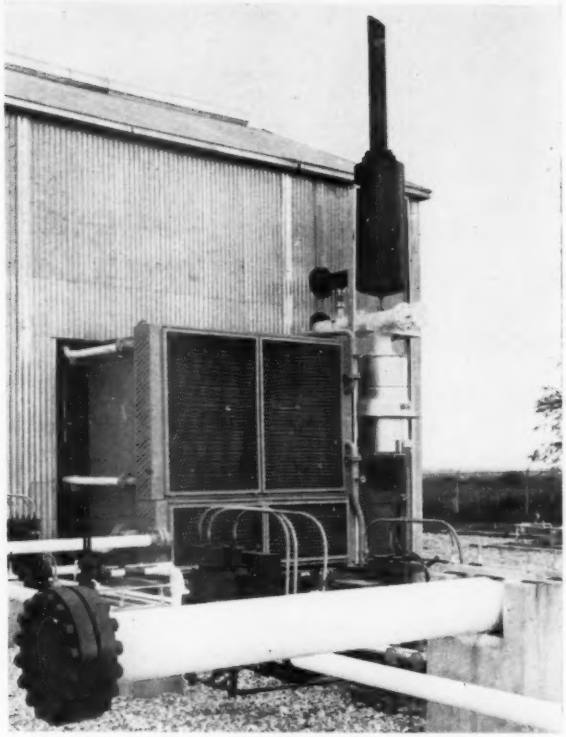
A. Warning signal controls

1. Low lube oil pressure
2. Low control air pressure
3. High jacket water temperature
4. High liquid level in suction scrubber
5. High lube oil temperature

B. Emergency shutdown controls

1. Failure to fire (starting sequence)
2. Incomplete loading sequence (loading sequence not completed within 45-second period)
3. Low lube oil pressure
4. Low control air pressure
5. High jacket water temperature
6. High liquid level in suction scrubber
7. Low oil level in force-feed lubricator
8. Low suction gas pressure (100 lb)
9. High discharge gas pressure (550 lb)
10. Engine over-speed (400 rpm)

When any one of the five warning controls or of the 10 emergency shutdown controls is activated, a signal is lit on the station control panel to indicate which malfunction is involved. An emergency shutdown signal will remain lit until a "reset" button switch is depressed even though the malfunction has cleared. It will be noted that the five functions included in the warning system are also included in the emergency shutdown system. In the event the malfunction is not serious enough to constitute a definite hazard, the warning system alone is initiated. If the malfunction then ceases,



the warning system is shut off. On the other hand, if any malfunction becomes serious enough to constitute a hazard resulting in an emergency shutdown, the station starting sequence cannot again be initiated until the emergency shutdown system has been re-energized manually. Thus the station maintenance personnel can readily determine which malfunction was involved in the emergency shutdown.

An isolated building is located at the compressor station to separately house the station control cabinet and panel, the telemetering transmitters and the radio equipment with associated multiplexing equipment. This building includes a separate room for station auxiliaries such as the instrument air supply compressor and the station standby generator with an automatic line transfer control. In addition to the five stations for the warning signal system and the 10 stations for the emergency shutdown system as previously described, the control panel includes the following devices:

A four position selector switch provides for each of the three normal operating conditions of "start," "stop" and "off." The fourth position is "remote." When the selector switch is in the remote position, the station is under full control of and can be controlled only from the remote location at the office in Gainesville.

Sequence signal lights are located just above the selector switch on the control panel. These sequence signal lights indicate the station operating condition. With the station selector switch in the normal stop position, the green sequence light will be lit, but only when all conditions are proper and satisfactory for the initiation of a starting sequence. When a starting sequence is initiated by setting the selector switch to the start position, the green light is shut off and a white sequence light is lit, indicating that the starting and loading sequence has been initiated. The white sequence light will remain lit until the full starting and loading sequence has been completed. With the station on the line and with the main block valve closed, the red sequence light is lit and the white light is shut off. In reverse, whenever a stop or and emergency shutdown condition is initiated, the red sequence signal light will shut off and the white sequence signal light will again be lit. When a normal stop sequence has been completed and the station is again in the normal down condition, the white sequence light is shut off and the green sequence light is again lit. If the station shutdown was the result of an emergency condition, the white sequence light will remain on until the emergency condition has been cleared, the emergency shutdown re-energized, and all other controls are in the proper position for a normal down condition, at which time the white light will shut off and the green sequence light will be lit.

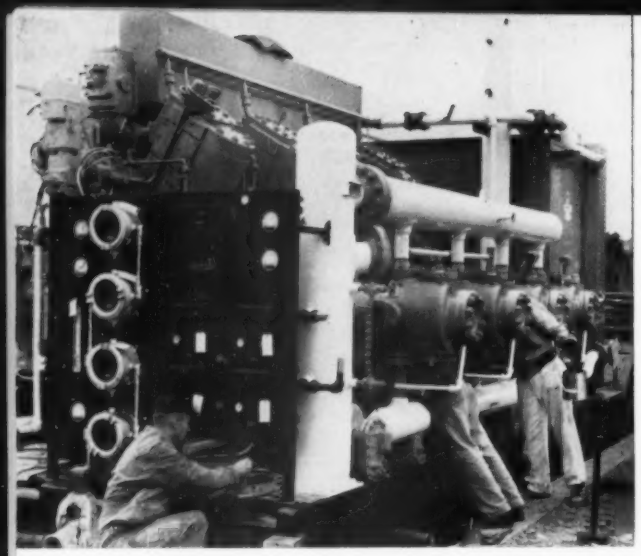
A separate switch is provided for manual operation of each of the station valves. These manual control switches may be used to operate a valve to the open or closed position only when the station is not operating on the line. If any valve is out of the normal position required for station start-up and loading, the loading sequence is broken and the station cannot be put on the line.

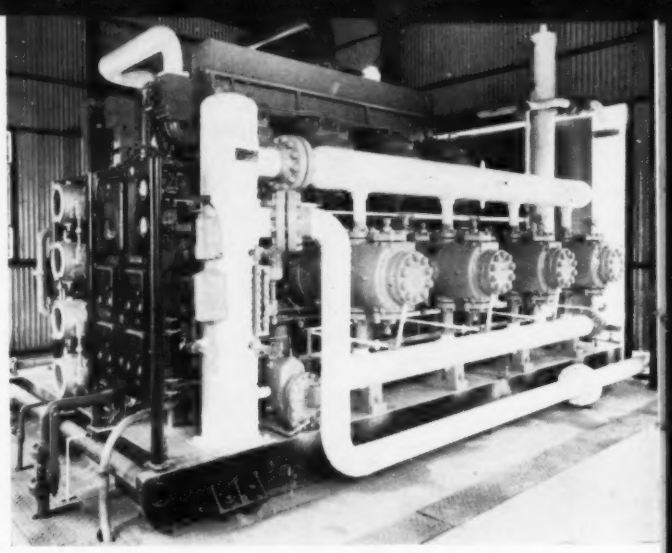
The station control panel also includes push-button switches for testing each of the emergency shutdown systems, the warning signal systems, and all panel signal lights. Push-buttom switches are included to re-energize the emergency shutdown system once the malfunction causing the shutdown has been cleared and to silence the station alarm horn. Whenever the alarm horn sounds, due to either a warning signal or an emergency shutdown condition, the horn may be silenced while the valve function is being cleared, at which time the silencing relay is re-energized to place the alarm horn back in the circuit.

The control console located in Gainesville was designed to provide the minimum of supervisory control essential to the remote operation of the compressor station. These essential requirements were considered to be:

A. Three position selector switch: This selector switch includes the positions "Start," "Stop" and "Off," similar to the positions on the selector switch at the compressor station. When the selector switch at the compressor station control is in the fourth "Remote" position, the selector switch at this remote control panel is in command.

B. Sequence lights: Green, white and red sequence lights function for the same purpose and indication as the three sequence lights located on the control panel at the compressor station.





In the Stearns-Roger yard in Denver, the 39-ton skid-mounted compressor and its auxiliaries are readied for shipping by rail to Georgia (left). After its trip, the compact unit was set on a concrete foundation in the station building (right). Daylight shows at the right, where the heat exchanger extends outdoors. Instrument panel and gas scrubber are shown at the left end.

C. Main block valve position indicating lights: A green signal light indicates that the main block valve is open and a red signal light indicates that it is closed. This is the only valve position which is remotely indicated. The main block valve is of prime importance, and it is essential that the operator at the remote controlling station be aware that the valve is in the correct position for all transmission line operating conditions.

D. Warning system and emergency shutdown system signal lights: When a malfunction at the compressor station results in a warning signal, an amber signal light on the remote control panel is lit so indicating. In the event of an emergency shutdown condition at the compressor station, a red signal light on the remote control panel so indicates. When either the amber or the red signals are lit at the remote control panel, an alarm horn also sounds to warn the operator of the condition. A push-button switch is provided on that panel to silence the alarm horn, but the signal light will remain on until the malfunction causing the warning signal has cleared or resulting in an emergency shutdown has been corrected and the emergency shutdown system re-energized.

E. Emergency shutdown reset switch: The remote emergency reset switch is provided so that the remote operator may reset the emergency control system in the event the malfunction causing the emergency shutdown may have cleared and the compressor starting and loading sequence can then be initiated. This is most important in connection with at least four of the emergency shutdown conditions:

1. Failure to fire—Upon occasion when the compressor station has been shut down for an extended period, the engine may fail to fire in the first starting sequence. In this event, the remote operator can re-energize the emergency shutdown system with the reset switch and again initiate the starting sequence.
2. Incomplete sequence—When in an initial starting and loading sequence the station valves fail to complete the loading sequence within the 45 seconds allowed, an emergency shutdown occurs. The remote operator can utilize the remote reset button to re-energize the emergency shutdown circuit and again attempt to place the compressor station on the line.
3. High discharge pressure—An emergency shutdown is initiated in the event the discharge pressure at the compressor station exceeds 550 lb. Such an emergency shutdown condition might be the result of inattention of the dispatcher, who will normally initiate the normal stop sequence before the discharge pressure reaches the maximum amount. If the dispatcher should be involved in other work and fail to observe that the discharge pressure has reached a satisfactory maximum condition, the station will protect itself against excessive discharge pressure by an emergency shutdown. Use of the remote reset button then eliminates the need for a special trip to the station for the sole purpose of resetting the emergency control system.
4. Engine overspeed—On occasion, an engine overspeed condition may be experienced during a starting sequence or during a shutdown sequence. When during the starting sequence the engine fails to fire promptly but does fire before the "fail to fire" emergency shutdown is initiated, the engine may be supplied with excessive fuel causing it to momentarily operate at a speed in excess of 400 rpm before the governor can take control. This will result in an emergency shut-

down. Here again the remote operator may use the remote reset button to re-energize the emergency shutdown circuit and may then re-initiate the starting and loading sequence without the necessity of a visit to the compressor station.

F. Telemetering: Information as to three operating conditions at the compressor station was felt to be essential to the dispatcher at the remote control point. These three operating conditions were: (1) transmission line pressure on the section side of the compressor station; (2) transmission line pressure on the discharge side of the compressor station; and (3) engine speed. Telemeter transmitters installed in the control room of the auxiliary building at the compressor station provide this data to companion telemeter receivers installed in the control console panel at the remote control point. The telemetering of pressures in the transmission line at the compressor station also gives the dispatcher information on the transmission line pressures at the mid-point during periods when the compressor station is not in operation.

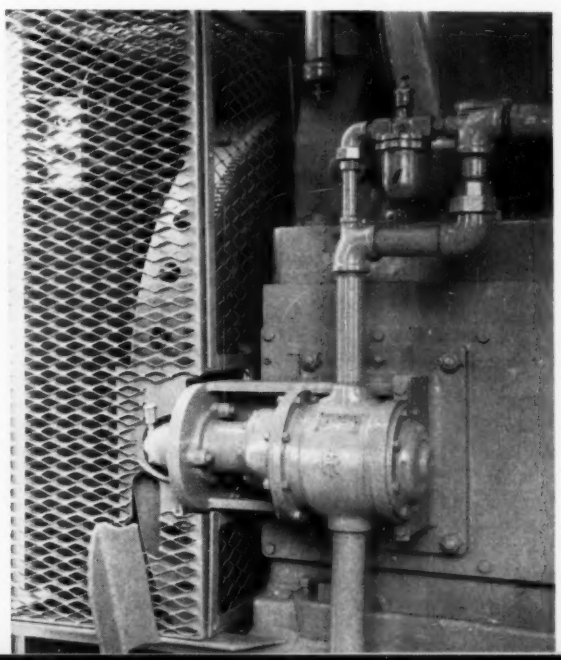
G. Telemetering pipeline terminal operating data: In addition to data as to basic operating conditions at the compressor station, it was felt necessary to provide information to the dispatcher at the remote control point on certain operating conditions at the terminus of the transmission line. These conditions were pipeline terminal pressure and the gas flow rate. Telemeter transmitters installed at the town border station provide this data through telephone lines to two telemeter receivers installed in the panel of the control console at the office. This data not only assists the dispatcher in the operation of the compressor station but also provides valuable information in connection with other gas operations such as the curtailment of interruptible customers and the operation of peak shaving equipment in the load control phase of the local operations.

Communications between the compressor station and the remote controlling point are attained through the use of microwave radio equipment manufactured by RCA with multiplexing through Convor audio-tone units. A total of 16 audiotones is used for this purpose. Since both the radio and the multiplexing conditions are not unusual or different than those commonly used in the industry today, and since this discussion is concerned primarily with the automatic and remote controlling of a compressor station, complete detail as to the radio and multiplexing equipment is not included.

As a final item of consideration in the design and construction of the compressor station and the control systems, complete provision has been made for the ultimate installation at the compressor station of a second compressor unit which may be controlled separately or in conjunction with the present unit. Provision was also made for attachment to the compressor station of a second looping transmission line. The construction at the compressor station is such that additions to the existing headers and buildings and the installation of a second control console and panel may be made without destruction or major revision of the existing installations. The construction of the control console and facilities at the remote controlling point includes duplicate switches, signal lights, etc., required for a second compressor unit. Inclusion of this additional equipment at this time was relatively inexpensive, and seemed desirable to assure matching equipment for future requirements.

Break-in tests of the engine compressor unit were begun in December 1957, and operational tests on the station automatic control system and the remote controlling system were initiated in January 1958. To date the station has operated satisfactorily when required, and no serious operational problems have been encountered. In closing this discussion, Ingersoll-Rand should receive special credit for the initial design of the supervisory control system, and Stearns-Roger and RCA also merit credit for their further assistance in over-all station design. ■

Auxiliary equipment (below) consists of standby electric generator and 3-hp motor driven compressor that provides compressed air for station use. Generator cuts in automatically in case of power failure. Ingersoll-Rand air motor (right) is connected to the flywheel of the engine-compressor through a Bendix drive.



MEASUREMENT

but not necessarily gas

By J. FRED EBDON, Editor

NOT all problems in the gas industry today are strictly down to earth. And it is not well for the mind to be restricted to basic everyday matters. Problems that may at first glance seem rather far fetched or are not associated with routine, tend to stimulate the intellectual appetite.

The Anglo-Saxon culture has many attributes. It should be needless to point out that this culture also has its disadvantages.

One disadvantage often noted is the smugness that radiates a connotation championed by many in the Anglo-Saxon world: Everyone is out of step except us. Thus, some progress often passes our culture by.

One bit of progress that has left the Anglo-Saxon group behind is the shift to the metric system of weights and measures. Practically every nation of the world has gravitated to the metric system at sometime during the past 150 years. However, our United States and our Anglo-Saxon friends have steadfastly remained aloof to this change and progress.

The latter statement is not altogether true, on second thought. There has been a subtle change to more practical metrical measurements even in the United States. As a matter of fact, medical men tell me that in the United States we enter this world on the metric system. All new born babies are weighed in grams. Somewhere along the line nurses, mothers or someone converts the new citizen from so many grams to a bouncing so many pounds and ounces.

Also of significance is the fact that the progressive pharmaceutical industry has switched from the English to the metric system. Then, too, electrical measurements are all based on the MKS system as are a good bit of the weighing and measuring in the chemical and electronics industries.

If one investigates with some faith, he quickly learns that science in the United States has largely changed to the metric system. There is little of the English system left in chemistry, physics, and other sciences.

Oddly enough the engineers are one group, along with geologists, who offer resistance to this change. It has been said that U. S. engineers do not understand the metric system. More probably they are simply determined that they are not going to understand the metric system.

No one is born with an understanding of either the English or metric system. Both have to be taught. But the metric system would seem more "natural" to the average human. Providence and evolution have given us two hands, two arms, two legs and two feet, etc. Each hand and foot has five fingers. In total, Homo sapiens has 10 fingers and 10 toes. Thus, we grow up with the numbers 2, 5 and 10 which would seem natural units of measurement. These numbers are the foundation of the metric system.

Are there any advantages to the metric system? The quick way to get an answer is to ask anyone who daily deals with grosses, Troy ounces, liquid ounces, quarts, dozens, grains, cubic feet, drams, British thermal units, etc.

But more specifically, it would be easier to calculate and convert in the metric system. This fact is of great importance when you consider that more and more people are doing ever more calculating and converting as the march of science and applied technology inexorably wields a deeper influence on the development and life in this world.

By use of consistent numbers of 2, 5, 10 and multiples thereof, calculations and measurements would become more accurate. Conversions would be reduced, bookkeeping simplified, and buying and selling on the domestic and international markets would be aided. And it would be to our great advantage to get on one system of units for science, commerce, industry and everyday life.

The last advantage to be listed here is perhaps the most important. This is one world now. Travel, communications, exchanges, aid and trade have brought all nations of the world together—economically and philosophically if not physically and politically.

No longer do we always stand in the front of scientific and industrial development. We can and should learn from the work of those in other nations. Similarly we should pass on the harvest of our learning to others. Why, then, do we hamper this interchange by using the English and other systems that make our scientific and technical publications hard to understand. Why publish learning in a state that many of our foreign colleagues will not understand what we are talking about? Why spend half the time converting units when reading the works of our foreign colleagues? Is it not true that we ourselves have trouble transferring the abominable units we use back and forth and in and out of metric units used by most of the rest of the world?

Does this have anything to do with the gas industry in the U. S.? Most certainly it does. The industry is quickly taking on a more international flavor. Renewed interest in moving and storing natural gas in liquefied or hydrate form (the former is as old as 1929) is generating a lot of international trade possibilities for the industry's fuel. Foreign pipelines and distribution systems beckon increase exportation of basic materials and instruments.

Instruments, for instance, with American calibrations (and, usually, at a higher price, too) have rough going on an international market where the metric system dominates. And with other gas system components the English system does nothing to facilitate foreign sales.

Gas measurement would, of course, seem quite odd to us if expressed in units of cubic meters, calories, and kilograms. However, our current use of a cubic foot—and one that isn't even standard in the first place—looks awfully odd to nearly everyone outside the Anglo-Saxon belt.

A quotation from H. C. Urey of the University of California at La Jolla is somewhat amusing as well as a source of food for thought. Urey said:

"Quite a number of years ago the Imperial Chemicals Industry of Great Britain switched to the metric system. During the war, I visited some of their big hydrogen compressors and, believe it or not, they pumped cubic meters of hydrogen gas!

"They would do it; they ran perfectly well. The lubrication didn't break down; nothing happened at all. It was really possible. At least machines can understand the metric system even if engineers in the United States cannot."*

The gas industry might do well to study the impact and problems that a switch from the English system to the metric system of units will produce. There can be but one conclusion as far as units and measurements are concerned. We are transitioning to the metric system in many fields and the advances in research of the past 20 years demand that we must use an accepted world-wide language of measurement. The United States will inevitably switch to the metric system.

Such switches do cause scientific and economic distress for some period of time. But this does not mean that a switch from a system that is costing the United States trade, time and money can't be accomplished. For example the whole world shifted from Ptolemaic navigation to the Copernican system. Not even the U. S. Navy (which still insists that the oceans' depths be measured in fathoms) has regretted the change.

Let's look at what is actually being done in the Anglo-Saxon world to encourage a change to the metric system. For one thing, the American Geophysical Union created a committee over a year ago to study the problem of introducing the metric system as a mandatory system in the United States. In Great Britain the British Association for the Advancement of Science is endeavoring to cause a switch to the metric system in that area of influence.

The American Association for the Advancement of Science has approved in principle the general adoption of the metric system of weights and measures. In addition, AAAS established a committee to consider the problems of shifting to metricity.

Just last winter all of the national standards laboratories of the English-system-using nations announced an agreement which defines the inch as 25.4 mm. This means that there is now an agreed mathematical relationship between English and metric systems on this unit of length. The American Standards Association and AAAS recommended this advancement.

It is interesting to note that India and Japan have had the experience of relatively recent shifts to the metric system. Perhaps it would be well for the gas industry to study the problems involved in gas industry operations by one or both of these conversions. The time to study the problem is before difficulties from it arise.

The gas industry would do well to immediately start study of its interests in relation to this seemingly underway modulation to the metric system. ■

* Dr. Urey made these remarks orally at the Lunar and Planetary Exploration Colloquim held at Griffith Observatory in Los Angeles, Calif., on Jan. 12, 1959.

Corrosion prevention

By CHARLES W. BEGGS, Senior Engineer, Corrosion
Gas Department, Public Service Electric & Gas Co.
Newark, N. J.

(Mr. Beggs prepared this article in association with the following New Jersey Committee on Corrosion members: G. A. Kelly, K. R. Lydecker, T. J. Maitland, E. T. Pearson, and L. W. Telesco.)

GAS exclusive

THE utility operator is faced with many problems. Perhaps the most expensive problem could be the corrosion of his buried system. Experts have estimated the cost of all corrosion at figures so large that they are astonishing.

Corrosion is a natural process used by nature to reduce all matter to its most stable form. Refined metals are particularly susceptible to this action. The result, as you all know, is rust. Fortunately, we can do something about it.

• The need for utility cooperation

Since all metallic structures buried in close proximity are subject to the same general problems, the cooperation of their owners is essential to a satisfactory solution of a corrosion problem.

In this article we will outline the problem and develop an answer for your consideration.

• Background of the corrosion problem

The electric street railway: Late in the 19th century, the electric street railway replaced the horse and cable cars. With this change, the corrosion of buried metal pipes and conduits was brought forcefully to the attention of the owners. Of course, soils had always been corrosive in many areas, but the stray railway current, returning over these metal paths to the substation caused serious, rapid corrosion where it left the metal to enter the ground. This fact did not go unnoticed and the railways were forced to establish mitigative measures to prevent this new damage to the buried structures of others.

While it was not fully realized at the time, the extensive areas over which the stray current was collected were furnished with a degree of cathodic protection. This fact and the efficiency of the mitigative measures were not realized until railway operations were abandoned in recent years. With this new turn of events, the soil and local cell corrosion, which had been stifled by stray current pick-up, again became predominant in the previously protected areas and required attention. Thus the value of cooperative effort became evident to utility operators.

In reference 1, the important papers and reports from 1894 to 1920 on the subject of street railway electrolysis are given. The harmful effect of electric railway current was reported by four different authors as early as 1894. In 1904 there was a report in the Transactions of the International Electric Congress on the "Electrolysis of Underground Conductors." In 1911 George F. Deiser of T. & J. W. Johnson of Philadelphia wrote upon the subject of

Cooperating companies conduct a joint test.

"The Law Relating to Conflicting Uses of Electricity and Electrolysis."

• Research at the Bureau of Standards

In 1910 Congress was sufficiently impressed by the stray current electrolysis situation to appropriate funds for investigating the causes and control of the problem.[2] Thus began a long and helpful series of tests and reports originating in the Bureau of Standards which have been the backbone of corrosion mitigation since that time.

Probably the period from 1910 to 1940 should be characterized as the "educational period" in corrosion prevention. It was a period of tests, investigation, trial and error, and through it all grew the feeling of interdependence between the operators of buried metallic structures.

It was recognized that one man's food could be another's poison and so the spirit of cooperation began.[18]

In 1945 G. R. Olsen[3, 4] wrote an article in *GAS* regarding the cooperative action needed between companies whose systems were adjacent, particularly when engaging in cathodic protection. Cooperation became essential to handle the operation and financial arrangements for such joint ventures. Once the principle of joint operation was accepted by all parties,

Corrosion became a real problem late in the 19th century when electric streetcars replaced the horse and cable cars.

NEW JERSEY COMMITTEE ON CORROSION

NOTIFICATION CIRCULAR

Number_____
Date_____

To The Secretary
New Jersey Committee on Corrosion

Company_____
Address_____
Representative_____Phone No._____

Reason for Notification

Rectifier_____Drainage Bond_____Other_____
Proposed_____Completed_____Changed_____Withdrawn_____

Location (Attach sketch if necessary)

Rectifier_____
Anode_____
Drainer_____
Connecting_____

Design Data

Rectifier_____Volts_____Amperes_____
Anode Type_____
Current Flow: Measured_____Estimated_____
Drainer: Size_____Length_____
Electrolysis Switch, Type_____
Pipe: Size_____Length_____Coating_____
Cable Plant Involved_____

Cooperative Interference Tests

Test Date_____Time_____
Contact_____Phone No._____
Address_____
Meet At_____
Remarks_____
_____
_____
_____

Notification circular.

simple general agreements could be arranged to eliminate the necessity for individual contracts for each job. The oil companies, who were the subject of the article, found it desirable to use simple agreements similar to joint-pole use contracts. Sharing of costs was based upon the amount of direct current drained from each facility. Local engineers made most of the deals and laid out designs. As time went on, mutual trust of the parties increased so that joint tests were abandoned and one engineer made tests and adjustments for all facilities and gave copies of the data to his counterparts in the other companies. The author mentioned that these were relatively simple situations, but he saw no reason why it could not be extended to conditions such as mutual crossing problems.

• History of joint corrosion committees

We do not know where the first cooperative corrosion committee was formed, but there is ample proof that there was a very capable joint electrolysis engineering study committee in existence prior to 1916. This committee was composed of three members each from AIEE, AERA, AREA, NELA, AGA, NGAA, AT&T, AWWA, and the National Bureau of Standards.

This committee made a preliminary report in 1916, followed in 1921 with its final bound report. This document should be considered as source information for stray current problems.[1]

In 1934 there was an active electrolysis committee in Pittsburgh.[8] This committee is still in existence and has been supplemented by the Western Pennsylvania Committee on Corrosion. This latter committee handles corrosion problems throughout the western part of Pennsylvania and coordinates with the Pittsburgh committee for problems in the greater Pittsburgh area.

The efficient handling of their often complicated problems and their educational efforts should be a model for the industry. This is not to say that they are alone in their work, since there were in 1951[5] a total of 23 similar committees in large centers of population around the nation. These committees are also engaged in similar activities.[22]

• The influence of NACE

In 1951 the principles endorsed by representatives of AGA, API, APWA, AWWA, AAR, EEI, Bell System, IMSA, WU Tel. Co., and USITA were given consideration in a "Report of the Correlating Committee on Cathodic Protection" published by the National Association of Corrosion Engineers.[5] This brochure* is a summary of information which should be in the hands of management before cathodic protection is attempted.

• Reasons for a cooperative corrosion committee

In the practice of cathodic protection, the interaction or the effect of one system on another is a necessary reason to establish cooperative effort between the neighbors. This cooperation must, of necessity, extend from design through test, construction, operation, and financial settlement. For this reason, it is wise to have an organization which facilitates the notification and discussion features of the plan and at the same time enables the corrosion people to get together in a spirit of friendship to work out problems which can become quite involved. The usual name of such a group is the electrolysis committee, committee on corrosion, or corrosion coordinating committee.[22]

During the effort to mitigate corrosion on a system, improper design of cathodic protection under some circumstances could adversely affect the signal systems of nearby railroads. For this reason, railroads are always invited to belong to these groups.

New Jersey had an electrolysis committee in the street railway era similar to those in other areas. As the street car disappeared, the work of the committee changed and the old committee evolved into the New Jersey Committee on Corrosion. This group was officially established by 35 operating companies of New Jersey in April 1954. As members, we have gas, electric, water, telegraph and telephone utilities, railroads, public authorities, and large industrial plants. Each member company has one vote when it is necessary to vote. New operators entering the area may be admitted upon their request to the committee.

Purpose. The purpose of the committee as set forth in the Constitution is as follows:

"The New Jersey Committee on Corrosion will function as a technical committee and constitute a clearing house for the exchange of engineering in-

* It is available from NACE headquarters, 1061 M & M Bldg., Houston, Texas.

formation on underground corrosion problems arising in the State of New Jersey."

• Organization and operating methods

Officers are president, vice president, and secretary. This latter officer is the work horse of the organization, since it is he who has to send out all the notification letters for protection projects.

No dues are assessed since it is expected that each member company will take over the various offices on a rotating basis. This covers the expense due to notification procedure.

• Policy and procedures

Some of you would probably like to know more about the policy and procedures used by the committee. The following excerpt is taken from the Constitution.

As noted under "Purpose," the committee is to be, essentially, a clearing-house for technical information pertaining to the corrosion problems that are of mutual interest to the member organizations. The committee will function in accordance with the following general procedure:

(a) The committee will not undertake any testing program, nor engage in any investigation, and will not make recommendations as a committee.

(b) As heretofore, each member organization will conduct such tests and surveys upon its own property as it considers necessary and shall be the sole judge of its own requirements.

(c) However, a member organization may request from the committee technical advice concerning its corrosion problems on an informal basis.

(d) A committee member may arrange with the chairman to place on the meeting agenda, for discussion, such corrosion problems as are of particular interest to his organization.

(e) The committee shall act as an agency through which the members can be advised of:

1. Planned cathodic protection schemes *before installation* so that interference tests may be conducted.
2. Completion of planned cathodic protection schemes when the final design or service date differ materially from the initial plan.
3. Proposed installation of drainage bonds whether to another underground structure or to the negative conductors of a traction system so that interference tests may be conducted.
4. The abandonment or alteration of any protective scheme by which they might be affected.
5. Major additions to the through transmission facilities of a member's systems where it is known that such additions may affect corrosion conditions on another system.

(f) Subject to member organization approval, the committee will act as an agency for the exchange of reports and information pertaining to corrosion conditions on the systems of the respective organizations.

(g) Questions before the committee shall be decided by mutual agreement and not by vote, except upon articles of committee organization or procedure not covered by previous articles.

(h) The committee endorses the procedures outlined in the publication by the National Association of Corrosion Engineers entitled "Report of the Correlating Committee on Cathodic Protection" and recommends their use when practicable and applicable.[5]

• Actual committee operation

Three regular meetings are held each year at a central location agreed upon by the members. At these meetings, recent Cathodic Protection Notifications are discussed and future plans are presented. Discussion continues on the subject of recent joint tests and if there are no objections, such projects are considered approved though no vote is ever taken.

In order to fulfill their educational responsibilities, the members will often provide an educational film or a speaker upon some corrosion problem.

Notification system: When a member contemplates a cathodic protection system, he will prepare a standard notification form, with full details and forward sufficient copies (one for every member) to the secretary. The secretary forwards these items to the

Testing pipe coating with a jeep.

membership, often several at a time. In the notification, a time and place is arranged for a meeting of interested parties to conduct a joint test on the proposed system. Usually ample notice is given and after the members make tests of the interaction on their systems, they will either:

1. Agree that it does not harm them.
2. Request certain changes to avoid damage to themselves, or
3. Show that the plan is such that interaction on them is so severe that some other plan must be worked out.

All objections offered in good faith are considered and alternate plans or adjustments are worked out.

• Technical practices for corrosion prevention

These are the methods by which the corrosion engineer studies his problem, works out his solution, and establishes protection. There are many methods and details to be considered, often very technical. In Bulletin III of Reference 5, the essential details are enumerated. In Reference 15, these methods are given an economic slant. In Reference 6, 500 references are given regarding cathodic protection methods since 1824, when Sir Humphrey Davey protected the copper bottoms of the Royal Navy, to as late as 1950.

In a general way, the various elements of a protection system are as follows:

Pipe coating: When the bare metal is protected from contact with the soil, the principal problem of the protective system has been met. Research by the Bureau of Standards has shown that a good protective material should be enamel-like, have a good reinforcement, and be present as a heavy layer rather than a thin film. Others have found that it should repel roots, bacteria, and other natural enemies such as rodents. In addition, it must have excellent electrical resistance and be capable of withstanding soil stresses, and preventing water absorption.

Insulation between various pipe materials: When two different metals are connected underground, an electrical battery is formed. In such cases, one metal, the anode, is consumed by the action of the soil, and the other metal, the cathode, is protected. Even new metal coupled with the same metal which has rusted will react to the detriment of the new metal. To overcome such problems, insulating joints are set up between steel, cast iron, copper, brass, and coated new pipe to prevent galvanic or soil corrosion.

Cathodic protection: If all pipe coating could be installed so that it was perfect when backfilled, corrosion mitigation would be simple. During the construction process, conditions are rugged and damage often occurs to the coating. To prevent rapid perforation of the pipe wall at such locations, a third method of protection is applied. This is cathodic protection, an electrical process.

If the damaged coating is placed in an electrical environment in which current is forced to flow from the earth into the flaw in the coating, such flow will neutralize the corrosive effect of the soil at the exposed locations on the pipe where current is trying to leave it. In effect, the pipe is connected to the negative side of a direct current source and the positive side is connected to a metallic anode which is buried in soil in the vicinity of the line to be protected. The d. c. source removes current from the pipe which leaks in at the coating holidays and discharges it through an expandable metal anode from which it is free to return to the pipe for a new cycle of neutralization of the galvanic couples existing. Protection is considered accomplished, by some engineers, when the pipe is forced 3/10 v in a negative direction when compared to the pipe to soil potential existing prior to protection.

Installing magnesium anode.

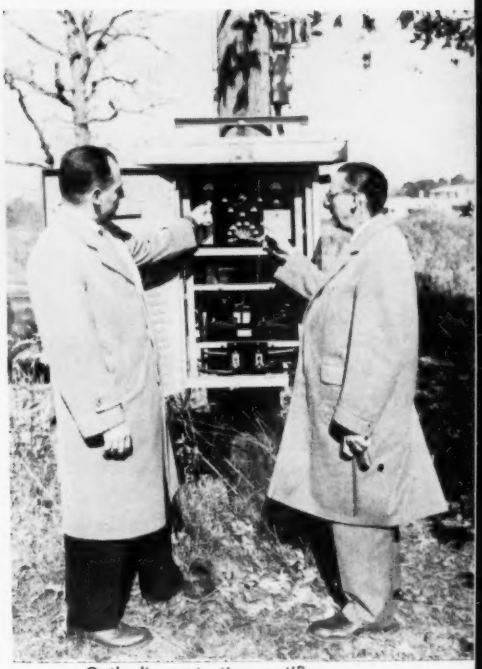
Another criterion is to regulate the protected line to a potential such that it is negative 85/100 of a volt to a copper: copper sulfate reference electrode at the weakest point in the system when measured to earth. Such measurements, of course, require proper instrumentation and trained personnel for successful use.

While it is possible to cathodically protect bare pipe, it is very expensive as compared to protection of a coated pipe. In addition, when such protection is applied to one structure in a city or an area of much underground piping, it can cause serious interaction on other structures in the area. In such cases, the protection project becomes complicated.[20] This means that pipe coating is the prime essential for economical cathodic protection.

The direct current sources used for cathodic protection are usually

1. Rectifiers which change commercial power to direct current.
2. Sacrificial anodes such as zinc or magnesium.

Searching for concealed damage.



Cathodic protection rectifier.

In addition, other sources such as storage batteries and wind-mill or gasoline driven generators can be used.

The galvanic or sacrificial anode, when electrically attached to a main and buried, becomes the anode of a battery and is consumed, but in the process it protects the main. The power output of such anodes is small so that their use is usually limited to coated mains.

• Accepted methods of correction of cathodic interaction

When one system with cathodic protection adversely affects an adjoining system due to interaction, a bond wire is usually connected between the two systems and its resistance is adjusted to fulfill one of the following principles: [8]

1. The original structure to soil potential of the foreign structure is restored. (Zero Swing)
2. Negative Coupling — A greater P/S negative reading of the foreign structure with the rectifier coupling made than without it.
3. Adjustment of cathodic protection current to allow a small current drainage from the foreign line.
4. A flat 100 milliampere current drain is taken from each foreign line crossing.

Stray current drainage: The fourth problem in this system is the handling of stray current of the direct current type from electric railways, etc. This is probably the oldest part of the protection science. It was discovered and a solution found in the trolley car era. The solution consists in determining where the return currents leave the buried metallic network to follow the earth path to the substation and introducing a heavy metallic conductor from this point to the generator negative terminal. By this means, the network becomes cathodic or negative to the soil and is protected by this stray ground current which is picked up and returned by the metallic cable to the substation. The metallic conductor is known as a bond or drainer.

In some cases where there is a difference in the location where the current leaves the network during the various phases of the day's traffic pattern, it may be necessary to include automatic switches in the drainers to prevent damaging reversal of current flow. Such switch gear may be polarized relays or rectifier stacks arranged to pass the current in the proper direction only.

A word of caution: While cathodic protection is generally quite satisfactory, it cannot stop existing leaks. If the condition of the system is such that an increase in pressure produces a crop of leaks, cathodic protection cannot prevent this. It has also been reported that a cinder or sulfur water environment makes cathodic protection difficult.

• Present day cooperation efforts

Houston: The protection of the gas mains in Houston is discussed in Reference 9. These mains had reached a high level of leakage before anything was done. The gas utility decided to cathodically protect with zinc. The coordination of interference tests with other utilities was hampered by the lack of a local corrosion coordinating committee. Nevertheless, every effort was made to prevent interference current on neighboring utilities. These utilities were notified of the proposed protection and tests were made for

their information when requested. The system installed has cut down materially on the number of leaks reported. A local corrosion coordinating committee has since been formed in this area.

Miami: Joint protection of all facilities in the city network at Miami, Fla. is discussed in Reference 20. In this case, all utility operators in the area participated jointly in the design installation and operation of a cathodic protection system. The protection was accomplished through the use of 11 50-ampere rectifiers installed in selected locations throughout the area.

Design methods could have been difficult and unreliable, but by proceeding with "cut and try" methods which were carefully checked for their effect on the systems involved during the installation of the system, a very satisfactory final result was attained. The rectifier anodes were installed in salt water rivers and in abandoned water wells.

Eight years later in 1955, the cooperative program was found to have provided good protection for the network involved. Failures were reduced to one per year.

Local systems: There have been some joint systems set up for mutual protection of adjacent buried structures in the New Jersey area. In one case, several sections of abandoned gas main were used as a distributed anode to protect a large cable system and a new coated gas main. The power sources used were rectifiers connected to the abandoned gas mains. The system has had successful operation for 15 years.

Miscellaneous: In Reference 4, we had the explanation of how parallel oil lines were placed under joint protection.

There have also been a number of small towns where the entire gas system has been cathodically protected.

• A plan for executive action

The obvious question then is, *"What Do I Do Now?"*

This will depend upon the manager's evaluation of his local conditions. He should in the first place—

Study his system: There are no two systems exactly alike and perhaps any similarity with another system is coincidental. A study should be made of such matters as leak experience, pipe material, pressure, size, coating, soil, pavement, costs, public relations, and building practices. In a usual situation when costs and public relations are considered, something will need to be done to prevent corrosion. It will be the exception where conditions are found so favorable that there is no problem with which to deal.

Hire a consultant: It will be advantageous to hire an outside expert in the beginning.[17] His trained eye will be valuable in making a study of the problems of the network. Since he is familiar with the latest methods and materials, he will more than save his cost in getting the program off to a good beginning.

Train company personnel: If the system is large, and much work is found necessary by the corrosion consultant, it will be essential to start training corrosion prevention personnel; both technical and practical. It may be found that the consultant will arrange to train a company engineer for a period of time. During such time and later, the corrosion consultant will do the more difficult jobs until the local personnel are able to take over.

Join the local corrosion or electrolysis committee: Membership in this group will be a must when the protection system gets underway. If there is no such committee, it might be the right time to get one started.[22] Experience has shown the difficulty of handling corrosion and electrolysis problems in the absence of such a group. Notification procedure is difficult and the normal educational value of the association of the experts is lost.

Set up construction standards: Set up construction standards and stick to them. If there is no guide for the use of construction and operating people, there will be too many different methods of doubtful value used to do something which requires expert guidance and training. These standards include specifications for pipe coating, insulating joints, electrical sources, test stations, and many other associated problems. Such standards can only be drawn by one who understands the problem.

Direct construction: The various steps of the master plan which have gone before have set the scene for the final step which management must take be-

Electrolysis drainage switch.

Training company personnel.

fore the system becomes a reality. That is, the establishment of a firm policy to provide corrosion prevention. That policy must direct that new construction and replacement work be built in conformity with the standards which have been set up. It will require time to make the policy effective so that a patient but firm attitude must be maintained for a period at the start.

• Conclusion

Most will no doubt agree that the protection of buried utility structures is a successful modern practice. Those who are aware of the possibility of accident as the result of corrosion of gas lines will recognize a desirable safety practice in these modern methods. The limitations of the system of protection are few, provided that it is understood that pipe which is corroded through is ruined although further corrosion can be stifled on such pipe.

If the cooperative effort of local utility operators can be secured, the corrosion engineer will be enabled to advance his science and practices to new areas of success. Such cooperation would doubtless set the stage for other regional protection plans, such as have been outlined in this paper.

For the accomplishment of such plans, your corrosion engineer will need management approval, a dynamic corrosion committee, and sufficient money. ■

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A GUIDE TO TRAINING SERVICEMEN—4

Central heating equipment

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GAS exclusive

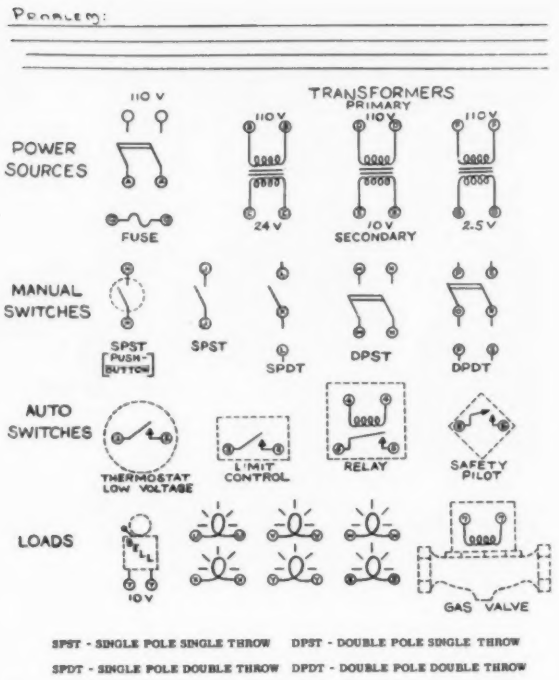


Fig. 1. Schematic wiring diagram sheet used as a training aid by Iroquois Gas Corp. in teaching basic electricity.

IT is only in recent years that gas has been so popular as a fuel for househeating. Previously, home owners were extremely cost conscious and the story of the advantages of automatic gas heating, even though many, usually fell upon deaf ears. Sales advertising emphasized the convenience features of gas, such as "clean," "automatic" and "efficient." The relatively few customers who purchased gas for heating expected additional value and if they received it in the form of additional comfort, then customer satisfaction was assured.

The changing economic scene has reversed the position of years ago so that it is now economically advantageous to heat with gas in most sections of the country. This has done more to accelerate the switch to gas heating than any other one factor. True, there are many other advantages to gas fuel, but these same advantages have existed for years.

This brings home one important fact; customers who buy on the basis of price alone can change away from the use of gas for heating as fast as they changed to it, but customer satisfaction, based on quality and comfort, will firmly establish customer goodwill beyond the effects of dollar-competition.

Our management has been keenly aware of this "satisfaction concept" for many years and has planned and developed a program of heating service which emphasizes the importance of customer satisfaction. The backbone of this program is the customer serviceman. So often, a simple adjustment, recommendation, or even an explanation can make the difference between satisfaction or dissatisfaction. True, many heating plant troubles are beyond such simple remedies and often major installation changes are necessary to correct the situations. Regardless of the scope of the problem, one thing is certain; the customer serviceman must be able to analyze and correct whatever problem is encountered. This ability to analyze and correct is developed only through a competent and extensive training program.

Iroquois Gas inaugurated its first formal training program in 1944. The results and the reactions of the servicemen attending indicated the desirability of the continuation and expansion of the program until today there are two separate programs being conducted simultaneously.

The basic program is conducted by the University of Buffalo and is divided into two 16-week sessions. The first 16 weeks are a general description of the gas industry and the second 16-week session covers customer service with particular emphasis on gas heating. All new service department employees attend a 3-hour session once a week. In addition, service department clerical employees and personnel from our sales and home service departments attend the first 16-week session.

The advanced program is conducted in cooperation with the Erie County Technical Institute. Service department employees who have completed the basic course are eligible to attend. Theory and practical experience are incorporated into the training program; the theory sessions are normally conducted by the institute faculty and the service application sessions by our staff members. Each class member at-

R. Warren Marsh, counselor for the heating and air conditioning program of the Erie County Technical Institute, conducts a class on control circuitry in the Iroquois classroom. He is using one of the control circuit test boards.

tends a 3-hour session every four weeks. Sessions are limited to approximately 12 members in a group. This means that the same topic is repeated for four straight weeks to insure complete coverage of all class members. All training classes are held during normal working hours with employees receiving regular wages while attending. Progress tests are given in both the basic and the advanced programs and are administered by the faculty of the respective schools. An analysis of these progress tests indicates whether the subject matter is being completely understood and whether there is a need for additional or supplementary class work.

It is our opinion that a competent gas heating serviceman must be familiar with these five basic points:

- 1. Why the human body needs supplemental heat.
- 2. Methods of supplying supplemental heat (residential).
- 3. Design and application of gas-fired heating systems.
- 4. Automatic controls and control circuits for heating equipment.
- 5. Analyzing and correcting the customer's problems.

In both of our formal training programs, we cover each of these points as a separate topic. The material covered in both programs is the same for Points 1 and 2. In addition, Points 3, 4 and 5 are expanded and elaborated upon in the advanced program.

The training program is based upon the subject matter in our Customer Service Training Manual. Since it is not practical to reprint the entire text, the following is a brief resume of the major points covered in each program:

- **POINT 1. Why the human body needs supplemental heat**

Here, the student is introduced to the physiological aspects of why the human body needs heat. The factors affecting comfort, such as temperature, humidity and air motion are defined and discussed. The relationship between these three factors and how the proper balancing of the three produces comfort is outlined. Basic experiments on dew point, temperature, evaporation and air motion are conducted in class to demonstrate these principles.

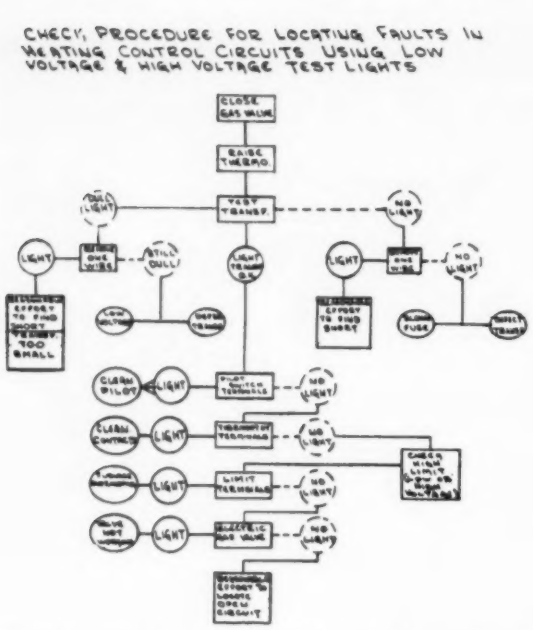
- **POINT 2. Methods of supplying supplemental heat (residential)**

The history of heating from early mankind to the present is traced with regard to the method used and the fuel employed. Present day heating systems are described and evaluated with respect to performance, installation and efficiency.

- **POINT 3. Design and application of gas-fired heating systems**

The fundamentals of heat transfer and heat losses from buildings are discussed in detail. Two methods of calculating heat loss are shown: the short approximate method and the more exact long method.

Central heating systems are divided into five categories: gravity warm air, forced air, gravity hot water, forced hot water and steam. Principles of op-



All service personnel carry this chart showing testing procedure for locating faults in electrical control circuits.

eration are discussed separately for each system. Design criteria such as size of ducts, cold air returns, radiator or register locations, equipment sizing and air velocities are discussed with reference to overall system performance. The advantages and disadvantages of each type of system are compared on the basis of installation, operation, efficiency and comfort. Conversion burners are covered with regard to installation practices as set forth by the American Gas Association.

There is installed in our classroom an operating unit of each type of system described. Class lectures are supplemented with the students performing various tests on the equipment.

• POINT 4. Automatic controls and control circuits for heating equipment

Individual controls such as thermostats, high-limits, safety pilots, gas valves and miscellaneous accessories and controls are each covered as a separate topic. Principles of operation, installation procedures, proper settings and control circuit analysis are covered with comparison checks being made for similar controls by different manufacturers.

In conjunction with Point 4, a basic course in electricity is given prior to undertaking any of the subject matter relating to control circuits. In the advanced program, students are required to trouble-shoot electrical failures on control circuit test boards. As seen on the accompanying photograph, these boards represent typical control circuit installations. A gas supply to a main burner and pilot burner is incorporated so that field conditions can be duplicated as far as practicable. On all of the test boards,

FUEL COST ANALYSIS

Date Installed _____ Sold by _____

ADDRESS 80 MAPLELEAF TOWN BUFFALO

NAME JOHN DOE

S.C. _____ Control _____ Line _____

Type Burner BARBER COAL BURNER

Type System: ☐S. ☐H.W. ☐V. ☐A.C. ☒W.A.

Make _____

Style and No. _____

Sq. Ft. Radiation or Leader Area: Required _____ Installed _____

Est. Dom. M.C.F. Annual _____ Mo. 5

House Construction _____

Insulation _____

Storm Windows _____

A Cons. of 30 CF per degree day will compensate for a heat loss of 59000 BTU/HR. and the cost at this rate for a normal htg. season would be approx. $150

I.G.C. 315 7M 11-57

Calculated Heat Loss | Heating M.C.F. Per Year | M.C.F. Per Degree Day

Month	Season 1957-58 Period End	Total M.C.F.	Net Heating	Degree Days	C.F. Per Deg. Day	Season 1958-59 Period End	Total M.C.F.	Net Heating	Degree Days	C.F. Per Deg. Day
Sep	27	4⁰				26	3⁰			
Oct	28	16⁶	11⁴	549	21	27	11⁹	5⁷	447	13
Nov	27	28⁸	23⁸	700	34	26	21⁰	16⁰	586	27
Dec	26	33⁴	28⁴	842	34	30	52²	47²	1447	33
Jan	29	51⁰	46⁰	1307	34	29	47²	42²	1284	33
Feb	28	46⁸	41⁶	1318	34					
Mar	28	31²	26²	875	30					
Apr	29	18⁰	13⁰	538	24					
May	28	11⁶	6⁶	345	19					
Jun	27	4⁶	—	130						
Jul	28	5²								
Aug	27	5²								
Total		257⁰	197⁰	6604	30		136¹	111¹	3764	30

Fig. 2. Fuel cost analysis card.

a number of trouble switches are installed on the reverse side; the instructor, by manipulating these switches, duplicates typical electrical failures that occur under field conditions. The student, who is told that a trouble condition exists, must correctly analyze the difficulty and recommend the proper corrective measure. All testing is limited to the use of 110-v and 24-v test lights. Test boards are constructed so that almost any gas valve or control element can be installed on any board. In addition, our training department has constructed cut-a-way models of various controls which can be installed on the test boards to demonstrate their operation. At present, there are four test boards representing a large number of control combinations.

They are—

Board 1—Series 10—3-wire, gravity heating system

Board 2—2-wire—forced air heating system

Board 3—Gravity heating system with self-generating pilot

Board 4—2-wire—gravity gravity heating system

Yearly, an electrical wiring session is held to review control circuitry. One of our best training aids for this purpose is a demonstration wiring board which incorporates basic electrical components. Work sheets which represent a schematic reproduction of the test board are distributed to all class members. (*See Fig. 1.*) The instructor verbally describes an electrical circuit problem and the student is required to draw the schematic on the work sheet. Upon completion, one individual is required actually to wire the circuit on the test board using the work sheet as the plan. To encourage class participation, students are encouraged to bring to class actual field problems that they have encountered.

As service aids, our training department has prepared a schematic control wiring handbook showing the most frequently encountered control circuits. A chart showing the testing procedure for locating faults in electrical control circuits has been reproduced in card form so it can be carried conveniently by all service personnel.

• POINT 5. Analyzing and correcting the customer's problems

One of the most common problems the serviceman encounters is the high bill investigation. Here, he must apply his knowledge of the first four points to correctly interpret the customer's problem and relate it to the actual conditions that exist in the heating system. To aid the serviceman in this task, we have developed the following approach to high bill orders. Any high bill investigation sent to the service department for further action has attached to the service request form, a "Fuel Cost Analysis" card. As shown on *Fig. 2*, this card contains monthly fuel consumptions for the previous and present heating seasons. Referring to *Fig. 2*, the following information is listed on the card:

a. Month and meter reading date

b. Total consumption for period (Mcf)

c. Net heating. Total monthly consumption minus average monthly domestic consumption equals net heating. (Assume average of July and August consumptions as representing domestic usage.)

d. Degree days for respective period

e. The last column is normally used to list the monthly ratio between net heating consumption and degree days (cubic feet per degree day). Occasionally, when a heat loss survey is available, the theoretical monthly net heating consumption will appear in this column. From this last column, a mean figure is calculated for both the previous and present heating seasons. This mean figure (cf/DD) for the present heating season is then used as the base to compute the information appearing in the lower left-hand corner of the form.

Armed with this information, the serviceman can identify whether the heating system is performing normally; whether the fuel consumption is out of proportion with the size of the building; whether trouble has developed in the system, and when this trouble started. With these facts the serviceman can give the customer a satisfactory answer to the high bill complaint.

Service engineer and author Richard Haas demonstrates the operation of a conversion burner in the Iroquois Gas classroom.

The correct evaluation of the results of a formal training program for customer servicemen is extremely difficult since it involves many intangibles and assumptions. If we can use as a comparison the old adage that "the proof is in the pudding," we can state definitely that our training program has been a success. In our territory, customer acceptance of gas heat has risen to the point where now approximately 76 per cent of our 352,000 customers heat with gas.

We strongly feel that our formal training program has resulted in increased customer satisfaction which in turn has contributed greatly to our overall growth. ■

After six years of natural gas, Lawrence Gas Co. asks

'Where do we go from here?'

By R. E. MAGUIRE, General Superintendent
Lawrence (Mass.) Gas Co.

LAWRENCE Gas Co. is one of seven companies in the gas division of the New England Electric System. Our franchise area is located in the northeastern corner of Massachusetts and consists of the city of Lawrence and the adjacent towns of Methuen, Andover, and North Andover—an area of 87 square miles with a population of 126,000. We serve approximately 33,000 customers.

In 1849 the company was incorporated as the Lawrence Gas Company and was enfranchised to distribute gas in the town of Lawrence. In 1877 the franchise area was extended to encompass the area presently served.

The company grew slowly but steadily in a region whose economic well-being was almost wholly dependent on the textile industry. Prior to the depression of the 30's several mills in Lawrence employed the bulk of the total available working force in Greater Lawrence (Lawrence, Methuen, Andover, and North Andover). Seventy-three per cent of the population of Greater Lawrence lived in Lawrence proper.

The depression brought economic chaos to the region. The mills shut their doors and left thousands of people without jobs. During the depression and up to the end of World War II the Lawrence Gas Co.'s growth was relatively static. At the end of World War II two things happened which affected the economic outlook of Greater Lawrence:

1) The huge areas available in the idle mill buildings were sub-divided and leased to many diversified businesses—as the result of intense promotional activity on the part of the Industrial Development Commission and the Chamber of Commerce. This acted as a stimulant to business and to employment.

2) The demand for new housing precipitated an exodus from Lawrence proper and an influx of new residents into the adjoining towns.

In the period between 1945 and 1958 the population of Greater Lawrence has remained relatively stable. The city of Lawrence, with an area of 6.75 square miles, has experienced a 16 per cent decrease in population (from 85,600 to 72,000). The towns of Andover, North Andover, and Methuen, with a total area of 80 square miles, have experienced a 26 per cent increase in population (from 43,000 to 54,000) in the same period.

The trend to the suburbs, coupled with increasing customer acceptance of gas as the ideal fuel, resulted in main extensions, gas service installations, and increased gas loads in the sections of our distribution system which are farthest from the supply of gas. This is a fairly common situation which is by no means restricted to the territory of the Lawrence Gas Co.

In the early 1900's, when our gas mains were being extended into Methuen and Andover, it was necessary to provide some means of ensuring an adequate supply of gas for these towns. This was effected by installing two boosted-pressure feeder mains:

1) 2.75 miles of 10-in. steel main was installed from the gas plant to Methuen and West Lawrence.

2) 3.5 miles of 8-in. steel main was installed from the gas plant to Andover.

The terminus of each feeder main was tied in directly to the low pressure distribution system. No pressure regulation was provided at the terminus of each feeder main. Pressure was controlled manually from the gas plant and was varied with the hourly load requirements in each town. In the early 1930's pressure telemetering equipment was installed from the low pressure mains in Andover and Methuen to the gas plant. Several years later house service regulators were installed on the low pressure services in the immediate vicinity of the terminal locations of the boosted-pressure feeder mains. At the time of

conversion to natural gas in March 1952, 1.1 miles of 6-in. main was installed from the city gate station to a new district regulator station in Methuen.

Prior to 1952, Lawrence Gas, like a majority of gas utilities in the New England area, was operating with production and distribution facilities which were being utilized almost to the fullest extent of their capacities. We were faced with the expenditure of relatively large sums of money to expand these facilities to the point where it would be practical for us to attempt to secure new loads. Effective promotion of gas for space heating or other domestic, commercial, and industrial uses of gas was not economically feasible under these conditions.

Fortunately the advent of natural gas in 1952 brought a welcome relief to the problems of producing and distributing gas to our customers. Plant generating facilities assumed a "stand-by" and/or "peak shaving" status. The capacity of our distribution system was in effect doubled by converting from a 528-Btu gas to a 1000-Btu gas.

Management then instituted a progressive and vigorous sales promotional campaign designed to stimulate the use of gas and gas appliances by all classes of customers. Particular emphasis was placed on securing the large and virtually untapped market available in the field of space heating. Promotion was also given to other domestic gas appliances and to a rental water heater program.

The success of these campaigns is evident when one considers the fact that the Lawrence Gas Co. experienced a 144 per cent increase in thermal sendout for the year 1957 as compared with the year 1951. Similarly the maximum day thermal sendout for this company increased 279 per cent in 1957 compared with 1951. On a volume basis, we experienced a 29 per cent increase in Mcf sendout for the year 1957 as compared to the year 1951. The maximum day Mcf sendout increased 98 per cent in 1957 as compared with 1951. In the relatively short period of 5 or 6 years since conversion to natural gas our loads have expanded to the point where we have exhausted the increase in distribution system capacity which was made available to us by conversion.

YESTERDAY . . .

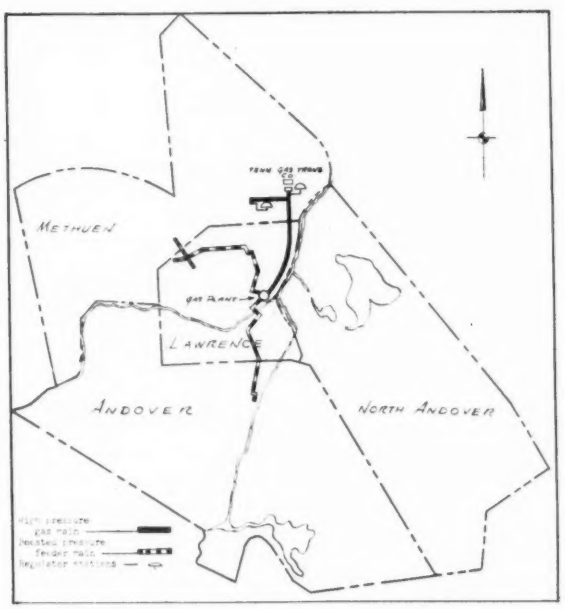


Fig. 1. Lawrence Gas Co.'s distribution system in 1956.

TODAY . . .

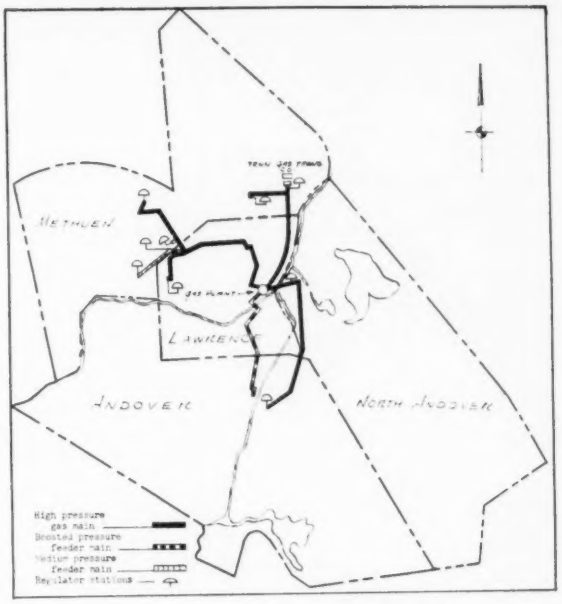


Fig. 2. The distribution system in 1958.

The large increase in load is attributable mainly to domestic house heating. Lawrence Gas has progressed from a negligible pre-natural gas heating saturation to a greatly expanded present day heating saturation.

In the field of merchandising ranges, water heaters, dryers, and incinerators we have made substantial progress. In recent years building contractors have become increasingly gas-conscious. This, combined with increased customer acceptance of gas as the modern fuel, has resulted in large increases in our domestic heating and non-heating loads. Commercial and industrial loads have also expanded due to intensive promotional efforts directed towards stimulating customer interest and acceptance of gas for space heating and for non-heating purposes. The sale of gas to three large industrial customers on an interruptible basis has recently been effected in our company. The relatively large volumes of interruptible gas have enabled us to secure additional revenue, fill part of the "summer valley" in our annual sendout curve, and substantially improve our annual load factor.

In general there has been no specific pattern to the geographic location of the increased loads. Most of the new home-building construction has taken

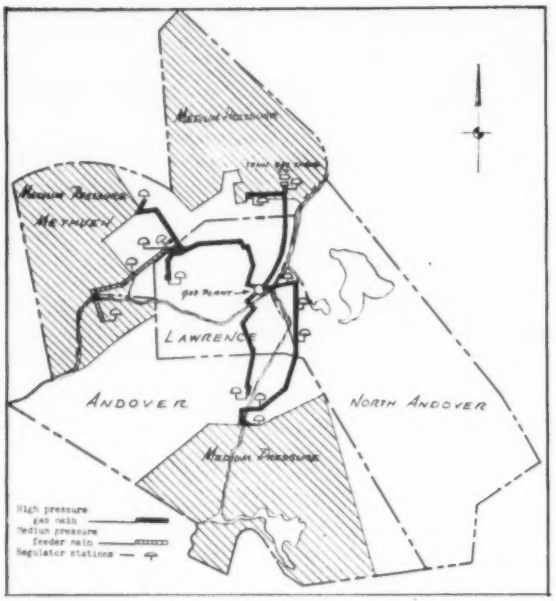


Fig. 3. Gas distribution system in 1978.

place in suburban areas or in previously undeveloped areas on the outskirts of our franchise territory. On the other hand a good portion of our increased load is attributable to the replacement of oil-fired heating equipment with gas-fired appliances either by existing customers or by new customers who were already on our mains. The same condition applies to our commercial and industrial load increase—some of the increased load resulted from the installation of new mains to new customers, and some resulted from replacement of existing customer's appliances using competitive fuels both for heating and non-heating purposes. The net effect has been one of increasing the gas loads in all areas of our distribution system, rather than in one or two specific areas.

As a result, the Lawrence Gas Co. has made substantial progress in securing additional gas loads, and we have a vast potential for future growth. At the present time we are securing the househeating and water heating load, at the very least, in approximately 9 out of every 10 new houses built in those sections of our franchise areas that are either on the mains or within a distance covered by our normal extension policy. It is felt that with the passage of time we will secure an even greater proportion of the potential load resulting from the construction of new housing.

In the field of old-age housing projects and low-income housing projects considerable inroads have been made by us in recent years on the advantageous position formerly enjoyed by competitive fuels. More and more of these housing projects are being built today with gas as the fuel for space heating, cooking, and water heating.

Because a large proportion of our total load is represented by space heating gas, our annual load factors have decreased since the advent of natural gas. In an attempt to improve our load factors we are directing our efforts towards the sale of interruptible gas and are awaiting developments in the field of gas air conditioning. It is felt that the development of gas-fired air conditioning units, which would be competitive from the standpoint of operating costs, would be a major contribution towards the solution of how can we best fill our summer valleys and thus improve our annual load factors.

A large market is now coming into being for us—a replacement market for the heating, cooking, and water heating appliances that were sold by our competitors and installed in homes constructed during the post-World War II housing boom. Now that gas in enjoying a degree of customer acceptance never before experienced, there is no doubt but that a good proportion of these appliances will be replaced by gas-fired appliances.

This leads us to consideration of the problem of how to increase distribution system capacity to adequately handle present and future expected loads.

Studies made by our gas division staff indicate that one of the most desirable methods of increasing the capacity of an existing distribution system utilizes the following as a basic premise:

Divide the distribution system into three general areas that are roughly comparable to 3 concentric circles—consider the outer ring as the high pressure area, the middle ring as the medium pressure area, and the inner ring as the low pressure area.

As regards the low pressure area, or inner ring, we feel that an adequate gas supply to heavily populated areas containing relatively large numbers of services can best be attained by reinforcement from the medium pressure area, or middle ring, with pounds-to-inches regulators. One of the opposing schools of thought would pressurize the low pressure area as a means of increasing distribution system capacity. Our objection to pressurizing the inner ring, or low pressure area, stems from the fact that to do so would necessitate the installation of a large number of curb cocks and house service regulators. Extensive joint clamping would probably be required to offset the effects of an increase in the volumes of unaccounted-for gas. By back-feeding from the middle ring we are providing a two-directional source of supply of gas to our low pressure area.

The medium pressure system in the middle ring may be affected by back-feeding from the high pressure system in the outer ring or by installing new medium pressure radial feeder mains from the gas plant to the medium pressure system.

Having the outer ring as a high pressure system creates a flexible condition that will permit growth in this area since, to state the case as somewhat of an oversimplification, increased pressures will handle increased loads. This obviously is subject to certain practical limitations regarding the condition of the mains and service regulators, and the maximum allowable operating pressures permitted.

Generally speaking the expansion plans for Law-

rence Gas are being formulated along these lines, i.e., high pressure for the fringe areas, medium pressure for the metropolitan areas, and low pressure for the sections adjacent to the gas plant.

Expansion plans or "master plans" have been completed for some of the gas division companies and are in process for the balance of the companies.* Each company's master plan is predicated on the development of the optimum distribution system that will effect the most efficient distribution of the gas loads to be expected 15 to 20 years hence, at which time we are anticipating a space heating saturation of at least 50 per cent in each of our companies.

Up to this point we have considered the types of load growth experienced since conversion to natural gas, and the possibilities of future load growth. We have considered our distribution system and, in general, the method in which we expect to increase the capacity of our distribution system. We have also mentioned that the chronological schedule of distribution system improvements is based on a master plan. The balance of this article will deal with some of the specific improvements planned for the Lawrence Gas Co.

Fig. 1 shows the distribution system as it was in 1956—267 miles of low pressure distribution main, 1.1 miles of high pressure feeder main, and 7.5 miles of boosted-pressure feeder main which discharged gas directly into the low pressure system. Pressure in the feeder mains was manually controlled from the gas plant to maintain 6-in. wc on the pressure telemeters located in Andover and Methuen.

At this point—1956—it was evident that we were approaching the capacity of our distribution system and also the capacity of the turbine-driven blowers which supply gas to the boosted-pressure feeder mains. Pressure surveys indicated that the distribution system was such that further load growth in certain areas would result in low pressure conditions.

A study was then initiated, with the development of a 20-year master plan as an objective. A complete and intensive survey was made of our existing distribution system, existing gas loads, and the relative location of these gas loads throughout the distribution system. Building trends, population trends, availability of land, proposed highway construction, proposed housing developments, proposed industrial park developments, and many other factors were analyzed and evaluated. In this manner estimated loads were developed at five-year intervals covering the next 20 years.

The existing distribution system was then divided into 54 sections and each section was analyzed after superimposing the projected load growth at five-year intervals. In this manner, we developed a chronological schedule of distribution system additions and improvements that will be necessary to adequately handle the gas loads expected 20 years hence.

The total cost of the necessary additions and improvements to the distribution system is estimated to be approximately $662,000. This figure represents the cost of revamping the pre-master plan distribution system and does not include the cost of main extensions which will be installed to serve new customers.

It was found that $445,000, or two-thirds of the total money involved in improving the distribution system, would have to be spent in the first five years. The first steps in our master plan were initiated in 1957.

At the present time, with the 1958 master plan improvements virtually completed, our distribution system is as shown in *Fig. 2*.

In the past two years we have installed 4.1 miles of 6-in. and 8-in. welded steel, coated and wrapped, high pressure main and two district regulator stations, all in North Andover and Andover. One regulator station is located in North Andover and the other regulator station is located in Andover. Each regulator station is designed to reinforce the low pressure grid in its particular area and is composed of dual regulators (pounds-to-inches). The regulators are installed in underground pits which are 25 ft apart, and are installed in series—with one regulator acting as a safety regulator to prevent over-pressuring of the low pressure system. The installation of this high pressure main has enabled us to serve two industrial customers with interruptible gas.

The open-end, boosted-pressure feeder main to West Lawrence and Methuen has been extended for 2.1 miles and converted to a conventional medium-pressure feeder main which supplies gas to five new district regulator stations in West Lawrence and Methuen. This feeder main also supplies one industrial customer in West Lawrence with interruptible gas.

A 1.1-mile section of 8-in. main in Methuen and West Lawrence has been converted from low pressure to medium pressure, after installing curb cocks and house service regulators on each customer's service.

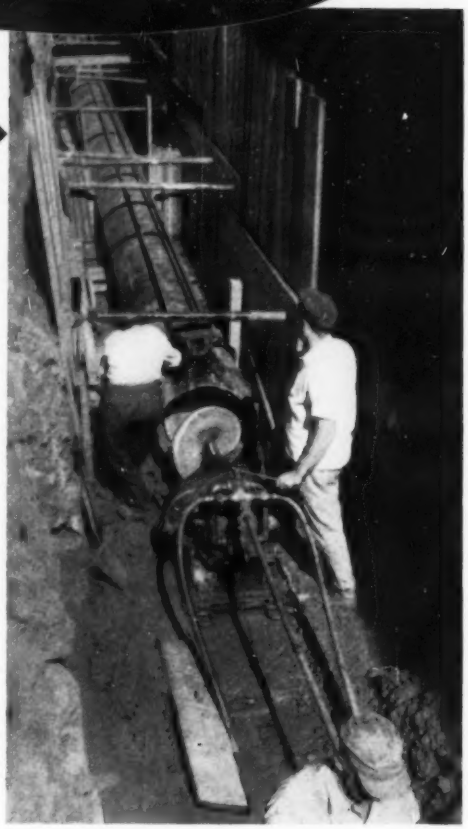
Pressure surveys are made each winter with recording pressure gauges to keep a close check on unforeseen load development in a given area. To date, our schedule of distribution system additions and improvements has followed the master plan but it must be borne in mind that our master plan is used as a guide and not as a rigid and inflexible rule. The exact chronological sequence of additions and improvements is subject to periodic review and careful study.

It is recognized that our master plan may prove to contain flaws in some of the basic assumptions and in the magnitude and location of the future expected loads. We do feel however that our plan is as good as present day information will permit. We also feel that it provides us with an excellent starting point

(*Continued on page* 92)

* See "Master Planning a Distribution System" by T. H. Rennell, Jr., NEES Gas Division, Malden, Mass., February GAS, pp. 68-70.

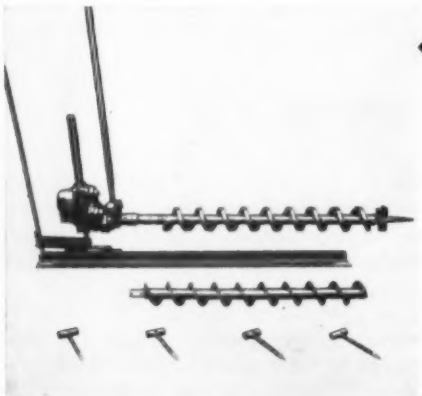
Drilling with KA-MO...



24-in. x 106-ft. bore *in only 4 hours!*

To install a gas distribution line under a railroad bed, this Ka-Mo 24" diameter horizontal drill bored a hole 106' long through hard compacted clay and ballast. Actual drilling time *took only 4 hours!* Drill was powered by an 18 h.p. air motor and installed casing as it made the bore. This fast, safe method of drilling and casing installation protects railroads, highways, etc., against costly cave-ins.

Next time you have a drilling problem, check the big Ka-Mo line. Drill sizes 2" to 48" dia. and larger . . . in sectionalized lengths . . . air, electric, hydraulic, gasoline, or diesel powered . . . tailored to meet your own particular requirements. Information is available at no obligation. Just call us, or mail coupon today.



Speeds installation of gas distribution lines

Here's a "close-up" of a 6" dia. horizontal drill with 6 h.p. vane type air motor and single-track mounting. It's light, portable, easy operating. Speeds installation of distribution and service lines under walks, streets, railroad beds, etc. Other sizes in this series: 3" to 14" dia. in sectionalized lengths with single or double-track mounting.

Mail to: KWIK-MIX CO., KA-MO Tools Dept., 1845 South 55th Ave., Cicero 50, Illinois

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TITLE_____
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Send free data on:
☐ horizontal ☐ vertical
☐ angular drilling equipment
Dia. of hole _____ in.
Length of bore _____ ft.
Type soil _____

KAM907 GAS

KWIK-MIX COMPANY — Ka-Mo Tools Dept.
A DIVISION OF KOEHRING COMPANY

GAS NEWS

Growth despite problems, says investment report

Despite the problems facing the gas industry, the Value Line Investment Survey expects the industry's earnings growth to continue.

The rising cost of money needed for expansion to meet the demand for gas will admittedly act as a depressant on earnings. But, understanding regulatory bodies are expected to allow higher rates of return on investment. This will compensate in part at least for the increased cost of getting new money. Some states are allowing returns up to 6.75 per cent, compared to FPC allowed returns of 5.5 to 6.24 per cent.

The Value Line Survey looks for one or both of the following developments in the next year or two: (1) an average return of 6.5 per cent allowed by the FPC; or (2) a price of gas at the wellhead nearing its "commodity value" will be found reasonable.

As long as growth in demand for gas continues, growth in operating income is automatic, even under existing regulatory processes. Assuming that the FPC will prove flexible in setting allowable returns, the survey expects gas companies to continue to show growth of earnings and dividends greater than the average for electric utilities or industrial concerns as a whole.

Gas option scholarship

New York State Natural Gas Corp. has awarded its 1959 Gas Technology Option scholarship worth $5,500. Winner is Robert G. Jump of Elmira, N. Y., who will enter Illinois Institute of Technology in the fall.

New York Natural will provide tuition fees while Jump is attending the school and summer employment during his vacation. Jump plans to study for a chemical engineering degree. In his senior year, he will take courses in the gas technology option which prepares young men for positions in the gas industry.

Gas for space heating sweeping Midwest

Peoples Gas Light & Coke Co. is joining other midwestern utilities in adding thousands of space heating customers to its lines.

Between now and Dec. 31, Peoples Gas expects to add 67,000 single family dwellings. This will make a total of nearly 330,000 individually heated single family dwellings in Chicago, or about 60 per cent of the 542,000 such units in the city. Peoples Gas will then be serving a total of about 350,000 space heating customers, compared with 39,000 at the end of World War II.

Peoples Chairman Eskil I. Bjork said that if proposed projects of two subsidiaries are approved in time, People Gas can make still further offers of gas heat later this year.

Still another increase in gas supply—expected on Jan. 1, 1961 from the Midwestern project—will make possible gas heat for new single family dwellings and apartment buildings to be built after May 1, 1960, and a new allocation of gas for year-round air conditioning.

Peoples Gas also wants to extend space heating to a limited number of multiple dwelling units with central heating plants, commercial and industrial buildings, and structures run by public authorities.

Porcelain enamel panels cover front of new 13-story Southern Counties Gas headquarters building in downtown Los Angeles. Project scored a first for this type of facing on a major office building in the Los Angeles area.

NOW ***from PARSONS . . . a complete line of WHEEL Trenchliners to fit any job***

Big things have happened since you last looked at wheel-type trenchers. Today, you'll find the *right answer* to your job . . . the *right size* wheel machine for lowest cost per lineal foot of trench, in the big, well-rounded Parsons® line. There's extra capacity, performance and dependability in every size. Check the chart below . . . pick the Trenchliner® that best suits your requirements . . . then contact Parsons distributor for a demonstration. See him soon . . . or mail coupon for more information.

MODEL	TRENCH WIDTHS	MAX. DEPTH	DIGGING SPEEDS
130	12 to 24 in.	5¾ ft.	12 in. to 18 ft. per min.
150	16 to 26 in.	5¾ ft.	12 in. to 25 ft. per min.
170	20 to 32 in.	5¾ ft.	12 in. to 25 ft. per min.
420	36 to 52 in.	7½ ft.	15 in. to 25 ft. per min.
520	40 to 52 in.	8½ ft.	12 in. to 28 ft. per min.

Also: 5 ladder-types for digging 6 INCHES to 6 FEET wide . . . up to 19 FEET deep

mail to: PARSONS Company, NEWTON, IOWA

Send literature on: ☐ 130 ☐ 150 ☐ 170 ☐ 420 ☐ 520 Trenchliner

NAME ..... TITLE .....

COMPANY ..... DIV. .....

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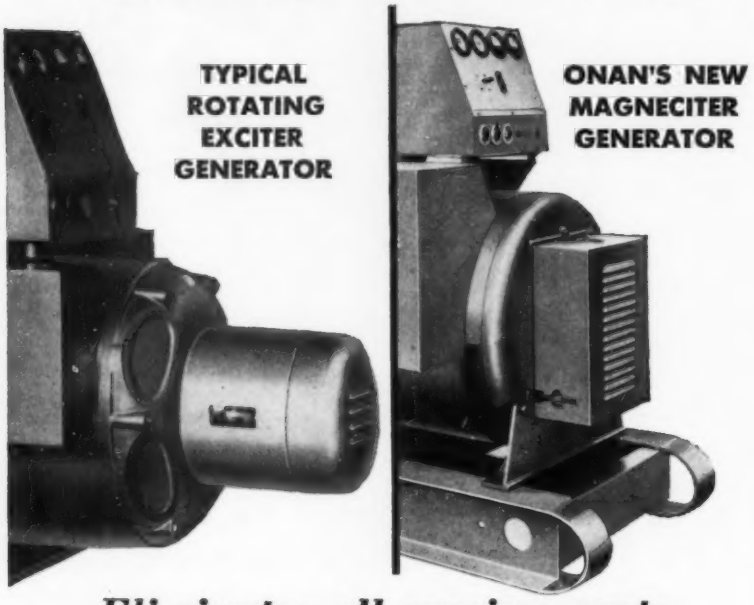
☐ Also interested in ladder-type Trenchliners P923 GAS

PARSONS Company • NEWTON, IOWA

A DIVISION OF KOEHRING COMPANY

THE "NEW LOOK" IN GENERATOR DESIGN

on large Onan gasoline and diesel plants



Eliminates all moving parts in exciter and voltage regulator

Steps up performance in primary and emergency standby installations

- ✓ ***FASTER VOLTAGE RECOVERY***—Rated voltage is restored within one second after load is applied or removed, compared with 5 seconds for a rotating exciter generator.
- ✓ ***LESS VOLTAGE FLUCTUATION***—Voltage fluctuation with load changes is less than half that of standard-type generators.
- ✓ ***GREATER RELIABILITY***—New design eliminates hundreds of electrical connections, the commutator and its brush rig, and many other "break down" points.
- ✓ ***FEWER ADJUSTMENTS***—No extra sensitive adjustments necessary. Regulator has no delicate multiple contact points.
- ✓ ***EASIER SERVICING***—All exciter and regulator components are easily accessible. No dismantling necessary.

New Magneciter generators are now standard equipment on all Onan Electric Plants of 100, 125, 150, 175 and 200KW, as well as on many smaller sizes. A choice of Diesel or gasoline engine power is available on most Magneciter-equipped models. Complete specifications on any or all Onan units will be sent on request.

Find Us Fast In The Yellow Pages

Onan builds a complete line. Air-cooled gasoline models from 500 to 10,000 watts; air-cooled Diesels in 3 and 5KW; water-cooled gasoline models from 10 to 150 KW; water-cooled Diesels, 10 to 200KW. Also separate generators, D.C. plants, and accessories.

Call the Onan distributor listed in your telephone book or write directly to us.

D. W. ONAN & SONS INC.

2863 University Ave. S.E., Minneapolis 14, Minnesota

Onan ELECTRIC PLANTS

Booklet warns about substructure damage

The Portland Utilities Coordinating Committee has published an illustrated booklet on how to "Prevent Substructure Damage." Paul H. Howe, distribution manager of Northwest Natural Gas Co., was booklet chairman.

The pocket-size, 16-page book is for contractors, utilities, public agencies and others who do excavating and other subsurface work in the NNG service area.

Its text points out the high cost and the danger in damaging underground mains, cables, pipes, and conduits. And, it urges preventive steps, such as asking utilities about the locations of buried structures.

Emergency phone numbers are listed for utilities and city and county works agencies.

Buys two Florida firms

City Gas Co., Hialeah, Fla., has contracted to buy the Caribbean Gas Corp. and Utility Gas Corp. Both companies operate in the southwest area of Dade county.

These are the fourth and fifth companies City Gas has acquired within the past 60 days as part of its $5 million expansion program.

The 3000 customers served by Caribbean and Utility bring close to 60,000 the number of customers served by City Gas in Dade and Broward counties.

Northern Illinois Gas engineer Thomas Snedden (left) has found a goldmine in the office suggestion box. He recently received an additional award of $2000 after the one-year review of a suggestion he submitted previously under the company's employee suggestion system. Added to the original $3150 Snedden received, the newest reward brings his total to $5150 for one suggestion. Snedden is demonstrating his device to NI-Gas executive vice president Edward D. Sheehan.

MEMORIES

Back in 1910, when the gentle glow of gaslight still illuminated many of the West's finest homes, our firm, (then known as Art Concrete Works) began serving the great and growing Gas industry. Throughout the years it has been our privilege to supply dependable, economical concrete valve and meter boxes to meet the industry's ever-increasing demands, as it fills the lighting, heating, refrigeration and power needs of homes, business and factories. Our memories of past pleasant associations are as bright and warm as gaslight itself; so is our anticipation of continued future service.

BROOKS PRODUCTS, INC.

Main Office & Factory:
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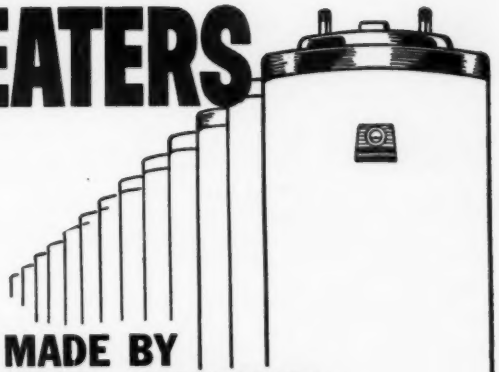
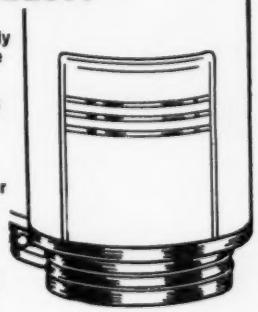
THERE IS ONLY ONE LINE OF PERFORMANCE RATED WATER HEATERS



IT'S MADE BY AMERICAN-STANDARD

THE PEOPLE WHO KNOW PLUMBING AND WATER HEATING BEST!

- With Performance Rating you easily match your customer's needs to the right size "rated" water heater.
- Performance Rating quickly makes you the water-heater expert; gives you quality and service to sell.
- Performance Rating means your customers won't run out of hot water
- Glass-lined or galvanized steel tank; 20 to 65 gallons; full price range.



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AMERICAN-Standard
PLUMBING AND HEATING DIVISION

A twilight view of the Parade of Homes shows the gas street lights in front of each of the 35 homes.

Gas top feature of Houston show

Gas equipment walked away with the honors at the recent Houston Parade of Homes and Home Show. Biggest exposition of its kind in the South, the show is sponsored by the Houston Home Builders Association.

United Gas Corp. and Houston Natural Gas Corp. started the ball rolling last September with a campaign urging Parade builders to "go gas." The local gas utilities knew the great influence the annual Parade of Homes has on the home-buying public. Result of their efforts: gas street lights lined the Parade grounds, and 33 of the 35 homes were all gas. Twenty-two used gas all-year air-conditioning.

Homes were in the $30,000-$35,000 price range. Each of the all-gas models featured built-in gas cooking units, gas refrigerators, water heaters, laundries, heating, and backyard gas lights.

The Geo. D. Roper Corp. rushed 14 new counter-top Rotis-O-Grills through production and air expressed them to Houston for a premier showing in the homes. Several builders added special enclosed patios and other out-door features to their original designs to make use of the contemporary gas-fired rotisseries.

Performance of the 22 Arkla-Servel air conditioners in the 90-deg. weather, large crowds, and constantly opened doors resulted in several additional sales for the builders of Parade homes.

The gas companies provided full-time staffing for the homes. Attendants were carefully trained to represent builders as well as the gas companies. Several homes were sold as a direct result of gas company representatives developing the prospects.

When Parade construction was under way, United Gas moved a "Blue Flame Headquarters" building to the parade site. A full-time gas equipment specialist was there to advise builders on proper installation and venting, location of outlets, etc. He also supervised air conditioning installations.

More than 159,000 visitors attended the show during its 15-day run.

In the home show, gas occupied one 3000-sq ft dome. In the center of the dome, 10 different built-in gas ranges were displayed around a 10-sided shaft. In the shaft were concealed two large air-handling units delivering cool air into the dome from two 7.5-ton gas Weatherbuster units located outside the dome. Around the perimeter of the display were 11 Gold Star free-standing ranges, eight gas dryers and combination units, plus a full line of Arkla and Bryant air conditioners, RCA-Whirlpool gas refrigerators, water heaters, gas lights.

Mich Con ad honored

Michigan Consolidated Gas Co.'s "hot water" car card ad was named "Car Card of the Year" by the National Association of Transportation Advertising. A panel of agency heads made the choice.

The winning card was prepared by the Cramer-Krasselt Co., Milwaukee advertising agency. It is one of a series the AGA offers to gas companies.

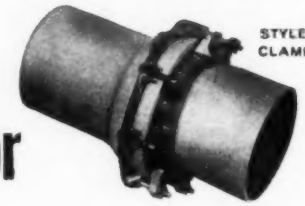
There is a Dresser®

STYLE 38
6-BOLT COUPLING

pipe coupling, fitting,

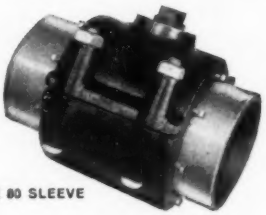
STYLE 90
STREET
TEE

repair clamp, or



STYLE 80
CLAMP

repair sleeve



STYLE 80 SLEEVE

for every need

Only Dresser manufactures a complete line.

DRESSER
MANUFACTURING DIVISION
Bradford, Pennsylvania

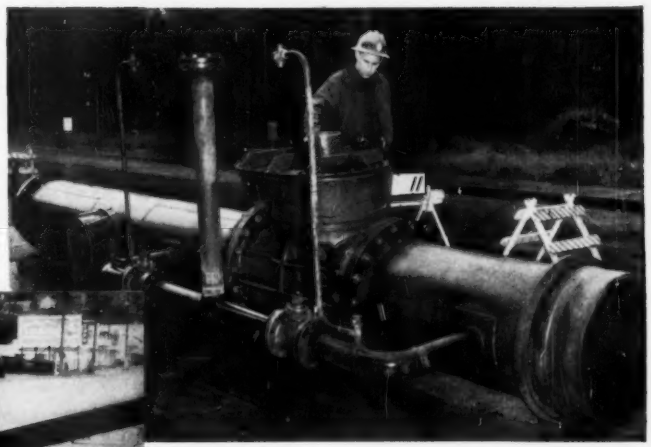
3-STEP VALVE INSTALLATION

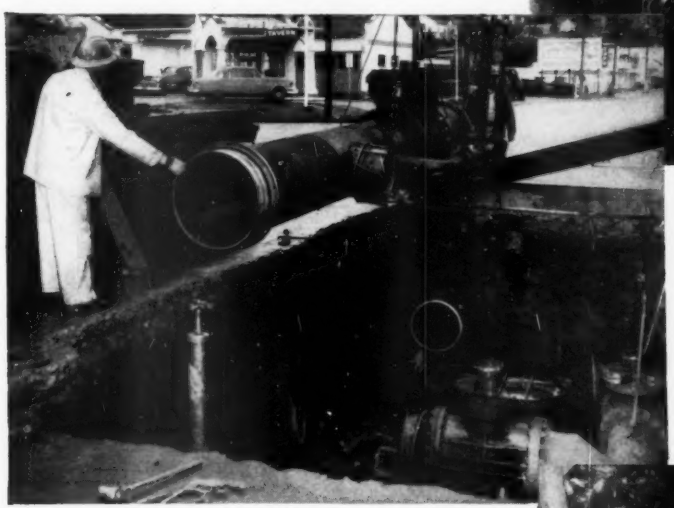
It's Fast and Easy with Dresser® Couplings

TIME is an important factor when a major feeder line shutdown is involved. Northwest Natural Gas Company of Portland, Oregon has developed a 3-step valve installation procedure that saves considerable time and vastly simplifies the whole operation. The sequence of illustrations shows how it is done.

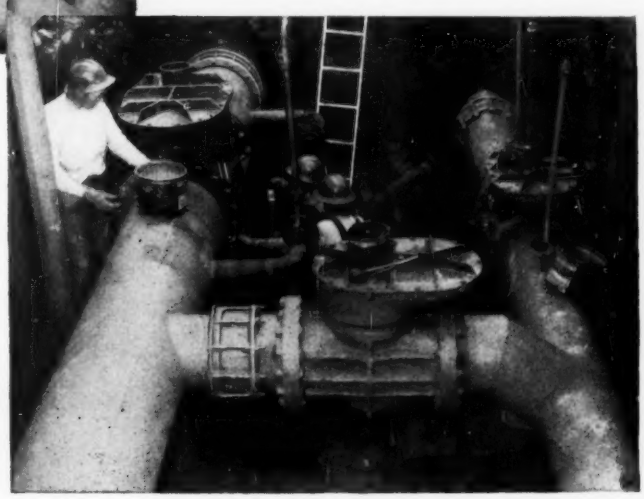
Dresser Couplings eliminate time-consuming, exact pipe fitting since they accommodate minor misalignments and still make positive, gas-tight joints. The time required for installation is essentially the two-man-minutes per bolt that it takes to make each Dresser Coupling a permanent, vibration-proof joint. And Dresser-Coupled joints will easily last the life of the line.

1. PREFABRICATION of the valve assembly speeds and simplifies installation, cuts shutdown time, and provides ample opportunity for joining and testing the joints of pipes with differing diameters or of differing materials *without the* excessive shutdown time required if this were done in the trench.





2. POSITIONING and lowering into the trench takes little time. The prefabricated valve assembly is complete with Dresser Couplings. Minor misalignments are readily accommodated; these flexible joints provide ample play for inexact pipe lengths or subsequent strains caused by ground settlement or vibration.



3. BOLTING UP the Dresser Couplings completes the installation. There has been a minimum of shutdown of the major lines; the installation has been fast, simple, economical . . . and most important, it is *permanent.*

DRESSER MANUFACTURING DIVISION

ONE OF THE DRESSER INDUSTRIES

Bradford, Pennsylvania • Chicago • Houston
New York • S. San Francisco • Toronto & Calgary

Bryant's air conditioner in production

Bryant Manufacturing's first 3-ton residential gas air conditioner rolled off the production line recently.

The air-cooled absorption refrigeration machine is designed for outside installation. It uses ammonia and water as the refrigerant and absorbent. The chilled water is circulated by an integral pump to a coil mounted in the furnace duct system. Motors for fan and circulating pump operate on ordinary house current, eliminating heavy electrical circuits. The unit is adaptable to any type of gas.

In Indianapolis, more than half a million dollars went for tooling and equipment needed for production. Bryant is devoting 75,000 sq ft of plant space to Model 36-450.

"Total approach" program launched by LILCO

A "total approach" plan to boost gas house heating and water heating sales was presented to plumbing and heating contractors by Long Island Lighting Co. recently.

What is needed, said general sales manager Lewis J. Jackson, "is not a series of uncoordinated promotion activities . . . ." He called for a realistic, hard-hitting program, spearheaded by professional sales training—a "total approach."

The first step in the program was taken in July 1958, when the company discontinued appliance retailing. At that time, LILCO turned over its share of the retail heating and water heating equipment business to its plumbing and heating allies.

The second step, according to Jackson, "was to develop a coordinated program of activities" to help the contractors help themselves to the vast market for sales.

First step in the six-point plan is for LILCO to set up a four-session, eight-hour "plumber sales clinic." Harold Lanchantin, training specialist, said the clinic is not designed to turn out professional salesmen. But, it is designed to give "a basic sales course designed to teach a plumbing contractor and his men how to recognize a prospect." The men also will learn how to convey to the prospect a desire to find out more about modern gas heat and water heating.

When he successfully completes the course, the plumber will get a LILCO gas heating specialist emblem and specially prepared sales aids and promotion material.

LILCO will follow up the clinic by stressing "heating specialist" in its advertising messages. The specialists also will receive field assistance and training from company experts.

Qualifications for the course: The contractors must have been in business for at least one year and must be primarily engaged in selling and installing gas-fired equipment. They also must have successfully completed LILCO's basic gas equipment installation course.

Union Gas developing newly acquired markets

Union Gas Co. of Canada Ltd. is devoting its 1959-60 construction program to developing recently acquired markets. Major emphasis will be on increasing gas sales in both the old and new markets.

About $12 million will be invested in new facilities, with most of it going for new services in existing markets. In the past two years, Union Gas has increased meters from 98,000 to 163,000. Gas sales rose from 15.2 billion cu ft to 25.3 billion.

Gaslite

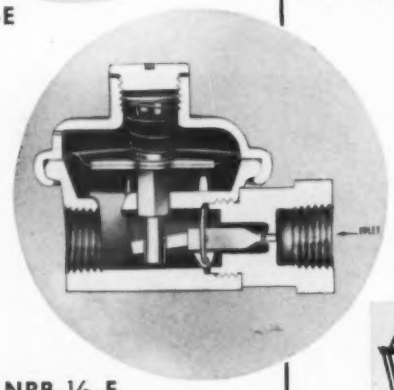
SERVICE REGULATORS

NR-⅛-E

NR-⅛-E
- An appliance regulator designed for inches w.c. to inches w.c. regulation.
- Insures constant pilot flame.

NRB-⅛-E
- A unit designed for flat rate gas lite installations ahead of meter.
- Construction similar to proven house service regulators by Reynolds.
- Inlet Pressure 1-60 Psi. Outlet Pressure Inches W.C.

May be installed inside Gas Lite Post.
Models available in ⅛" and ¼" I P S or any combination.
Units individually packed.



NRB-⅛-E

REYNOLDS GAS REGULATOR COMPANY, Inc.
ANDERSON, INDIANA, U.S.A.
A Subsidiary of Arkansas Louisiana Gas Company

McDONALD

THE QUALITY NAME IN GAS SERVICE STOPS

When you buy McDonald iron body gas service stops, shown below, you're assured of many years of long service. They are manufactured from the very finest materials. Over 100 years of engineering skill and experience in manufacture are further assurances of the very highest quality. Look for the name McDonald next time you buy.

iron body service stops

PLATE 10685

PLATE 10687

Where valves of this type are required or preferred, Plates 10685 and 10687 are guaranteed to give satisfactory service. All stops have iron bodies and bronze keys which are precision fitted and individually lapped. Each valve is individually tested and packaged in standard cartons to comply with A.G.A. specifications. Available in black or galvanized finish. Sizes — ½", ¾", 1", 1¼", 1½", 2".

For information on the complete line of McDonald gas service stops, write for free catalog.

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Dept. G-859, 12th & Pine
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Peerless® GAS UNIT HEATERS

Most Advanced Heater on the Market

Peerless delivers you all the performance you need to profitably sell gas unit heaters. These quality unit heaters are expertly engineered to provide maximum performance with both low initial and operating costs. Peerless includes features that afford peak efficiency—aluminized steel heat exchanger, live rubber motor mounting, our own foundry-produced cast iron burners, scientifically designed louvers for best heat direction, motors especially manufactured for unit heater application, and a high-quality steel jacket handsomely finished in modern gray-green.

A complete line of Peerless unit heaters is available for any type requirement—fan and centrifugal blower types from 25,000 to 200,000 B.t.u. All Peerless heaters fully meet the requirements for the American Gas Association and can be used for natural, liquefied, petroleum, mixed or manufactured gases.

Good unit performance means profits — to you. You'll get it with Peerless.

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GAS *Peerless* *The modern fuel* THE MODERN HEATER

PEERLESS MANUFACTURING DIVISION
OF DOVER CORPORATION
LOUISVILLE 10, KENTUCKY

Larger line planned

A second gas line is planned for the Fraser Valley of British Columbia. B. C. Electric said the $7.5 million line will triple the company's gas shipments to the Lower Mainland. Construction will begin early next year.

First planned as 24-in., the line was increased to 30-in. when gas demands exceeded expectations. The new line will parallel an existing 18-incher.

GAS' publisher is judge in AGA's PR contest

Frank Chapman, publisher of GAS magazine, and the presidents of two national public relations societies will judge AGA's third annual public relations achievement contest. Serving with Chapman are H. Walton Cloke, president of the American Public Relations Association, and Carroll R. West, president of the Public Relations Society of America. Cloke is PR coordinator for Kaiser Industries Corp. West is vice president and manager of the public relations division of Title Insurance & Trust Co.

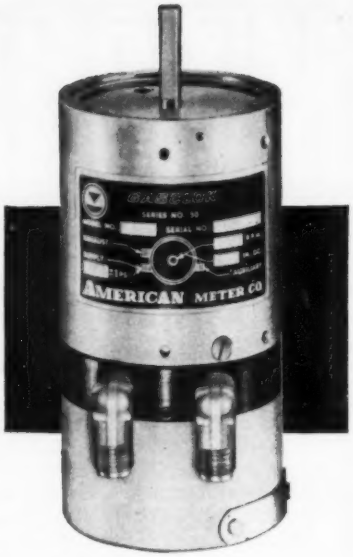
For the first time, the competition will be conducted in a number of categories, with a trophy awarded in each. A larger trophy will go to the company judged to have the best program.

NI-Gas adding thousands of heating customers

Northern Illinois Gas Co. has mailed heating permits to 65,000 residential applicants. The customers have one year to install heating equipment.

Illinois Commerce Commission okayed the company's plan to modify its space heat restriction order. Multi-unit dwellings, schools, churches, municipal buildings plus commercial and industrial establishments can now have gas service on a limited basis. Gas for heating hasn't been available to these customers since 1946 when the restriction order became effective.

The Humpty Dumpty restaurant in Old Greenwich, Conn., is gas lit—both inside and out. Lining the approach to the restaurant are these Arkla-distributed Welsbach-style gas lights. Wall type lights (right) illuminate the inside. In all, 80 gas lights are used, 53 inside and 27 outside. And gas lights aren't the only gas-burning equipment used. Cooking, heating and water heating all run on gas. Gas cooling is being installed. Five of the six fireplaces have gas lighters.



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GASCLOK

POWER

DRIVE

Completely self-contained gas or air-powered instrument driving and timing unit for long, trouble-free operation in remote locations. The GASCLOK delivers more than 20 times the torque of conventional spring-wound mechanisms. Continuous timing accuracy is unaffected by a ± 20% variation in supply pressure.

Inherently explosion proof and self-starting, the GASCLOK is ideal as original or replacement equipment for strip chart and conventional circular chart instruments. The timing mechanism is internally sealed to prevent corrosion, and all power unit parts exposed to gas are aluminum or stainless steel. Large area internal ports prevent clogging. Normal air or gas consumption 5 cfh . . . operating pressure 5 psi . . . rotation 2 rpm.

AMERICAN METER CO.

AMERICAN®

METER COMPANY

INCORPORATED (ESTABLISHED 1836)

Executive Offices: Philadelphia 16, Pa.
Sales offices in principal cities.

ADD LOADS . . . . . +
SUBTRACT COSTS . . . . . —
MULTIPLY PROFITS X

SIMPLE ARITHMETIC PROVES

WELDED STEELCASE METERS BEST

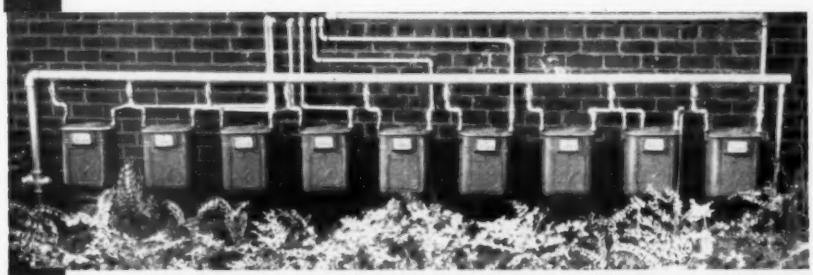
Modern American® Welded Steelcase Meters combine hardcase durability with proven tinned steelcase performance to provide a new approach to the economics of meter maintenance and retirement.

Low first costs – long-term maintenance savings. Major repairs eliminated – minor repairs and adjustments are easy to make assuring long service life.

Lifetime weather and corrosion resistant finish stays attractive in both indoor and normal outdoor settings. Special impervious coating for highly corrosive atmospheres also available.

Sustained accuracy is built into these meters with proven speed ratio and the many time-tested quality features and refinements pioneered by American in more than 120 years of meter engineering.

Ask your American representative about Welded Steelcase Meters and their many advantages for all fuel gas services.



American W-210 Welded Steelcase Meters in this Southern Alabama installation insure dependable, accurate measurement and long-term outdoor service without rusting.

W-210 Welded Steelcase Meter
Rated capacity 210 cfh for medium-sized homes with heating.

W-75 Welded Steelcase Meter
Rated capacity 75 cfh for average homes without central heating.

W-45-LPG Welded Steelcase Meter
Rated capacity 45 cfh propane for average domestic services without heating.

AMERICAN METER COMPANY
INCORPORATED ESTABLISHED 1836

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SUPPLIERS TO THE GAS INDUSTRY for Ironcase, Tinned Steelcase, Aluminumcase and Welded Steelcase Meters • American-Westcott Orifice Meters • Instruments • Reliance Regulators • Apparatus • Valves

S-7-L Diaphragm only, without carrier wire and gaskets

Lancaster

Non-Crack SYNTHETIC DIAPHRAGM

- **no need to change standard parts or gear ratios**
- **no cloth lining, no fabric failure**

No other synthetic material can match the flexibility or even approach the **service-proved** performance of the Lancaster S-7-L and S-700-L diaphragms for Sprague 1-A Gas Meters.

Developed and improved over 7 years, Lancaster Synthetic Diaphragms have also been **laboratory-proved** — recording without failure the equivalent of 50 years of average domestic consumption per meter.

And the superior performance is built into the diaphragm itself . . . no need to change standard parts!

Other Lancaster non-crack synthetic diaphragms available are: S-700-L for 1-A Sprague (carrier wire and gaskets attached); C-1-L for #1 Ironclad and No's. 0-L and 1-L for #0 and #1 Emco meters.

Every Lancaster Meter Part Deserves Your Confidence . . . They're made to last the life of the meter!

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Report issued on organic sulfur in gas

A research report on "Identification and Determination of Organic Sulfur in Utility Gases" has been published by the AGA.

Discussed are analytical methods for accurately determining the types and amounts of organic sulfur compounds in natural and manufactured gases.

The report is the result of an extended research effort conducted at the Institute of Gas Technology. A major portion was financially supported by the gas operations research committee as part of the AGA's PAR plan.

Northern Indiana issues space heating permits

Gas for home heating is a reality for more than 25,000 residents of northern Indiana. The PSC approved of Northern Indiana Public Service Co.'s request to issue permits to 45,000 new home-heating customers over the next three years.

The new gas supply will come from the Midwestern Gas Transmission system.

NIPSCO president Dean Mitchell said customers are in the company's northwest gas distribution system. Included are the cities and towns of Hammond, Munster, Highland, East Chicago, Whiting, Crown Point, Gary, Hobart, Michigan City, La Porte, Valparaiso, South Bend, Mishawaka, Elkhart, Goshen, Plymouth, Rochester, Warsaw, Peru, Logansport, and Wabash.

With the addition of these 25,000 heating customers, NIPSCO will be serving about 100,000 home-heating customers by the end of the year.

ALG gives away cement to boost industrial growth

Arkansas Louisiana Gas Co., which numbers a cement plant among its subsidiaries, is offering free cement for construction of industrial plants. ALG expects that the industry attracted by these structures will boost its gas sales volume.

The offer isn't limited to the ALG service area, however. ALG says it will furnish free cement for construction of industrial buildings to any municipal industrial development agency in Arkansas. Cities and towns accepting the of-

fer have to transport the cement from the Foreman, Ark. plant to their industrial site. Community corporations set up to build factories are widespread in Arkansas.

President W. R. Stephens said "We feel that this is a practical method of assisting industrial development and lessening much of the cost confronting our communities in providing plant buildings."

GAS • News Notes

Cribben & Sexton Co., Chicago, has sold its Constant Comfort gas space heating business to Suburban Appliance Co., Whippany, N. J. Production equipment and inventory will be shipped from Cribben & Sexton's Michigan City, Ind. plant to Suburban's plant in Dayton, Tenn.

Arkla Air Conditioning Corp. has named Thos. F. McNally Associates, Kalamazoo, Mich. as agents in Michigan and northern Indiana. McNally will handle the Sun Valley residential gas air conditioner, Humphrey unit heater and space heaters, and Arkla gas lights.

Fisher Governor Co. played host to 60 supervisors and administrators from U. S. Canadian and Venezuelan utility and pipeline companies recently. The men attended a four-day study course at Fisher's Marshalltown, Iowa plant.

Dresser Industries Inc. has sold its interest in Hydrocarbon Research Inc.

Peoples Gas Light & Coke Co. is refunding some $4.5 million to Chicago gas users. Refunds are in the form of credits on bi-monthly gas bills. The sum became available when a supplier's rates were reduced.

Hays Manufacturing Co., Erie, Pa. is celebrating its 90th anniversary. Producer of brass and iron stops, valves and fittings, Hays started out as a small shop with a handful of employees. It now occupies an up-to-date, 235,000-sq ft plant employing some 500 workers.

West Tennessee Gas Co. sold its natural gas facilities in Humboldt, Brownsville, Covington, Ripley, and Henning. The Tennessee cities will operate the facilities.

Checked 'em all . . . got
Far More for My Money
when I bought this terrific new
RIDGID® 535
Pipe & Bolt
Threading Machine

Pats. Pending

Complete with
1 Universal Die Head, 2 Sets of Dies
for ½" to 2" pipe or conduit

Looks good, does better. Perfect cutting, reaming, threading fast . . . and easy! Three tools operate independently . . . swing up out of the way for short pipe chucking from front. Slip-proof Speed Chuck is a great performer. Concealed oil system, automatic shut-off nozzle. Quick-opening die head sets to size right in machine. Power? . . . RIDGID-built motor handles 2" pipe, conduit, bolt, rod —and 12" geared tools easily. Try it, compare it . . . and you'll understand its enormous popularity! Leg and wheel stands available. At your Supply House.

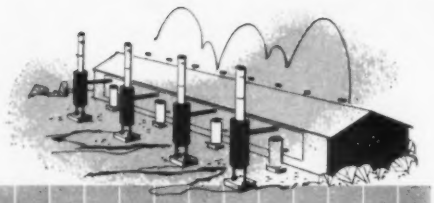
Time-savings on just 3 large jobs more than paid the $460.00 price!

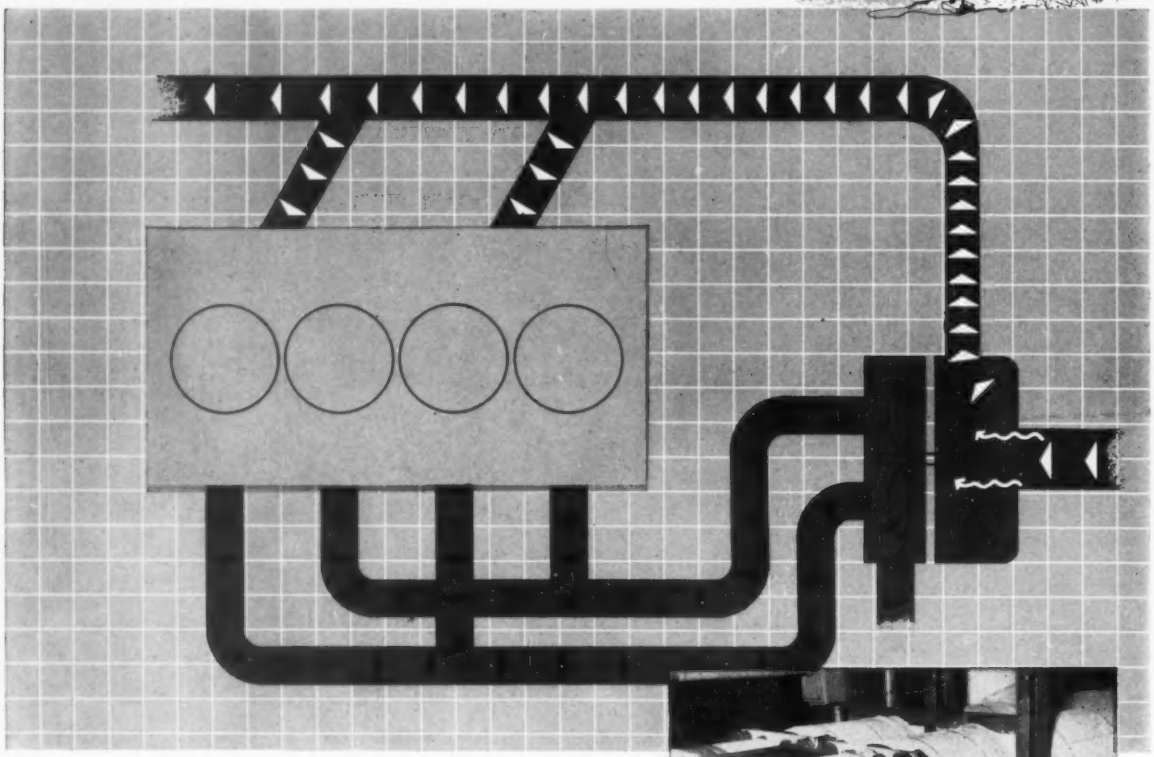
The Ridge Tool Company Elyria, Ohio, U.S.A.

THREADED PIPE . . . It's Tight . . . It's Best . . . Costs Less!

Flexonics

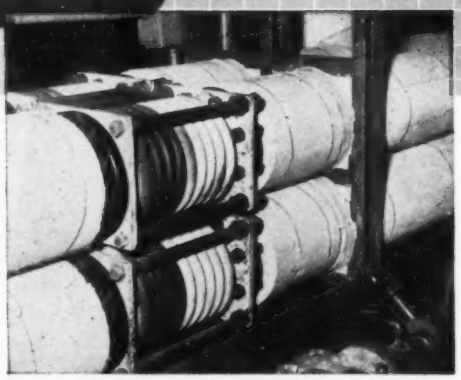
has the engineering experience to help you solve exhaust expansion problems when you turbocharge compressors





Here's a lively subject – *increasing gas pipeline capacity by turbocharging existing compressors in the field.* If you want the answers to the expansion problems that arise when the exhaust piping becomes an integral part of the operating loop, call on FLEXONICS engineers. They have the *specific* experience in this field that can mean actual dollar savings to you.

Write today for your free copy of this easy-to-read report. It tells you the dollars-and-cents facts that led an important pipeline company to a complete turbocharging program.



Special-design FLEXONICS Expansion Joints in the exhaust piping of a newly turbocharged compressor station.

Member Expansion Joint Manufacturers Association

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GAS ASSOCIATIONS

Trans-Canada's Tanner heads Canadian group

New president of the Canadian Gas Association is N. E. Tanner, director of Trans-Canada Pipe Lines Ltd., Calgary.

First and second vice presidents are, respectively, R. C. McPherson, senior vice president of Canadian Western Natural Gas Co., Calgary, and O. L. Jones, vice president and general manager of Consumers Gas Co., Toronto.

Directors: D. Cass-Beggs, Saskatchewan Power Corp.; J. W. Kerr, Trans-Canada Pipe Lines; T. C. Cross, Quebec Natural Gas; G. M. Douglas, Union Gas of Canada; G. E. Downie, Wilcolator (Canada) Ltd.; Frank A. Schultz, Trans-Canada; J. H. Hobbs, Bryant Manufacturing Co.; R. K. Farris, Northern Ontario Natural Gas; L. Milano, Quebec Natural; J. McMahon, Inland Natural Gas; J. W. Ostler, Canadian Meter; W. L. Dutton, United Gas Ltd.; O. E. Zwanzig, B. C. Electric; T. C. Walker, Switson Industries; G. W. Parker, Mueller Ltd.; B. F. Willson, Canadian Western Natural.

AGA publishes new Range Feature Finder

A new expanded edition of the "AGA Gas Range Feature-Finder" has been published.

The eight-page reference guide contains latest information available on current free-standing and built-in gas ranges.

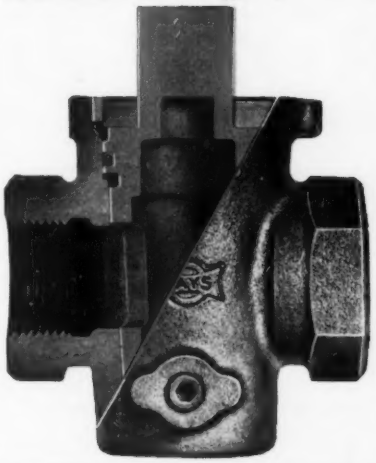
Copies of the 1959 edition are available from the AGA, 420 Lexington Ave., New York 17, for 15 cents per copy.

Michigan gasmen elect Simpson

John B. Simpson, vice president of Consumers Power Co. in charge of gas operations, was elected president of the Michigan Gas Association.

A. V. Brashear, vice president of Michigan Consolidated Gas Co., Detroit, is vice president. Milton G. Kendrick, also of Michigan Consolidated, is secretary-treasurer.

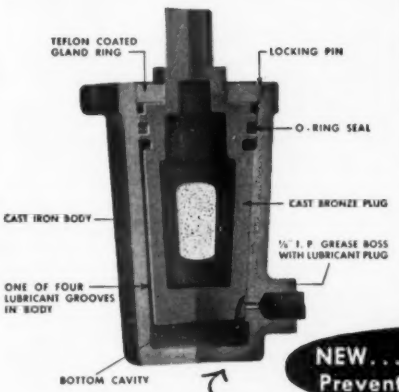
THIS GAS STOP WILL NOT STICK...



- A newly designed HAYS Lubricated and Tamper-Proof Gas Stop . . .
- Stop is completely lubricated at the factory . . .
- Four Grooves in body, and Lubricant Plug provide for pressure re-lubrication . . .
- Locking Pin positively prevents tampering at top of stop . . .
- O-Ring prevents top leakage . . .
- Teflon Coated Gland Ring reduces friction between top of plug and gland ring...

Re-Lubrication does the TRICK

HAYS LUBRICATED TAMPER-PROOF SAFETY GAS STOP*



- Lower initial and turning torque . . .
- Extra grade gray iron body, gas service bronze plug . . .
- Individually tested . . .
- Black or Galvanized, Flat Head or Lockwing Pattern...
- Sizes: ¾", 1", 1¼", 1½", 2", for 125 psi. W. P.

Write for Folder 121 and prices.

*Patent applied for.

NEW... Solid Bottom Construction Prevents Leakage and Tampering

HAYS®

GAS SERVICE PRODUCTS

HAYS MANUFACTURING CO.

ERIE, PA.

Washington • *Cont'd.*

from page 17

coal mining industry. Answers to slack sales and chronic unemployment through better marketing techniques, new uses, and better mining methods, are the goal.

Under the measure, the commission would be in business for only five years. The ceiling of $2 million in annual appropriations would apply only to the first year. Sponsors say the commission would be temporary and designed only to find immediate ways by which the coal industry could strengthen its hand in the market battle.

But this isn't likely. Once the commission is created and a new bureaucracy established, it isn't likely that it will be disbanded. Such commissions rarely are.

With Senate approval expected quickly (the upper chamber passed similar legislation last year) backers of the coal industry immediately began to talk up creation of a permanent fuels agency. Such a project would take several years to sell, and would probably be ripe for creation about the time the coal group is due to wind up.

Even members of the Federal Power Commission, perhaps with an eye to expansion if it could take over the task, are endorsing the idea.

FPC vice chairman William R. Connole supported the principle of an industry-government agency to recommend legislation for a "meaningful, practical and equitable" national energy policy in a speech before a National Coal Association. The national energy board is an NCA pet.

Mr. Connole, whose FPC is constantly faced with coal industry opposition to natural gas projects, urged the coal industry to take the lead in establishing a quasi-public fuel policy study group, with gas, oil, atomic energy and coal industries represented.

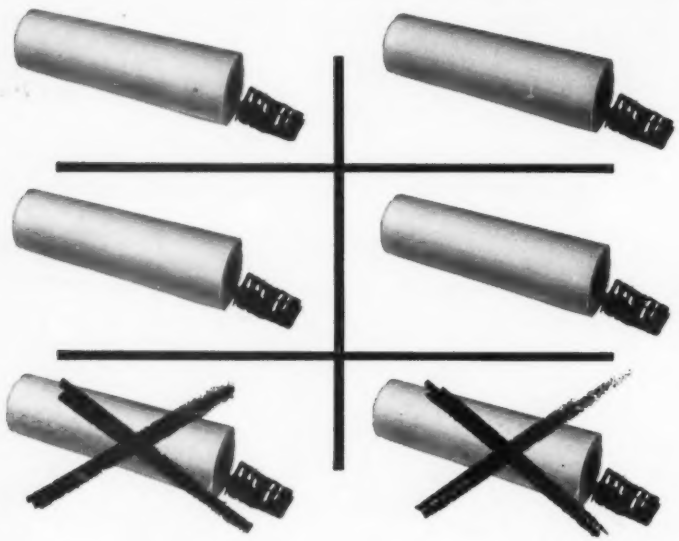
Such a group should hold hearings, study, and work for new legislation in fuel taxes, rate-making, customs, and conservation fields, he said.

A few days after the Connole speech and House passage of the coal commission bill, Sen. Frank E. Moss (D., Utah) called for a congressional study leading to establishment of a national fuels policy to set the program in motion.

The government, he said, "is doing almost nothing to solve the problem — equalizing competition among energy-producing fuels." The most dangerous aspect of the problem is the national threat from allowing the coal industry to disintegrate, he claimed. He predicted that in another 15 years gas, oil, and nuclear power will not be able to meet all energy requirements and "coal will have to come to the rescue."

One coal industry spokesman claims that even by 1975, nuclear power will be equivalent to only 50 million tons of coal, and the coal industry will then "have to supply" 475 million tons for power generation and other 425 million for other uses.

THE FPC will have to hold extensive initial rate studies before



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With Standard Magnesium High Current Anodes you get more ampere hours of protection per pound of metal consumed . . **plus** 50% more current output **and protection** than with conventional anodes.

Let one of our sales representatives give you the full story on how Standard Magnesium High Current Anodes give greater protection at lower cost.

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These Three Informative Booklets on Corrosion:

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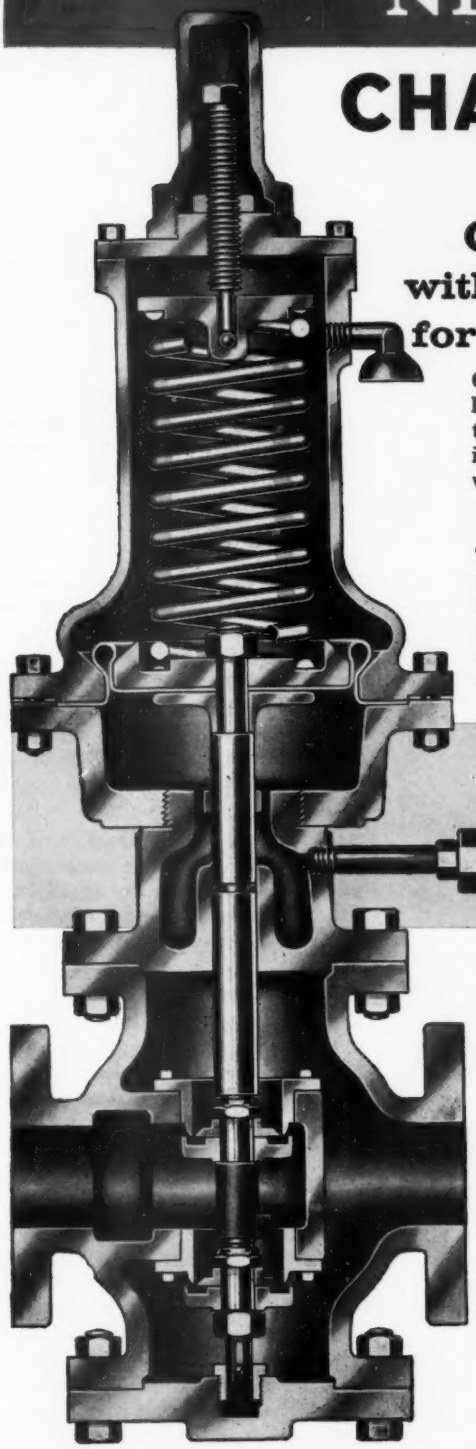
NEW IN DESIGN!



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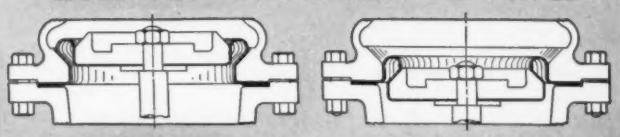
GAS REGULATOR
with "ROLL-OUT" Diaphragm
for constant pressure control

Chaplin-Fulton Model 57-S is a simple spring loaded regulator which performs like a pilot loaded regulator, without the added complications. For pounds-to-pounds service—inlet pressures to 400 psi—controlled pressures to 75 psi, with deviation through full valve travel less than 1 psi.

NO "FALL-OFF" AS FLOW INCREASES

The drooping characteristics or outlet pressure "fall-off", typical of conventional spring regulators, is eliminated—not by using an uncontrollable velocity effect—but by a new diaphragm design which actually reverses the action of a conventional diaphragm. It changes its area as the valve opens to compensate for the loss in spring loading force.

"ROLL-OUT" DIAPHRAGM PRINCIPLE



VALVE CLOSED VALVE OPEN

Note how, with the valve upwards in the closed position, the diaphragm achieves its maximum effective area—and decreases as the valve opens. The area changes at the same rate as the spring loses compression, to give a constant controlled pressure—determined entirely by valve movement.

2" - 3" - 4" - 6"

Write for Bulletin 57-S

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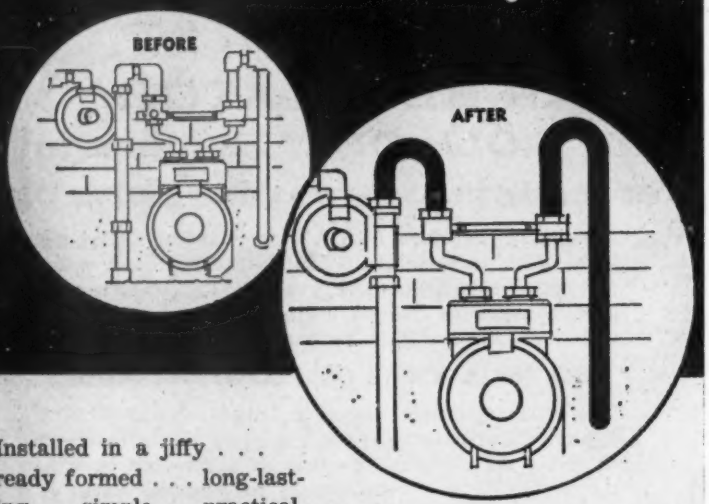

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- 90° and 180° bends
- ¾" - 1" - 1¼" pipe
- threaded one or both ends
- special shapes, if desired

Write for details and prices or for representative to call.

Manifolds and Supply Pipes for Gas Appliances

THE PRODUCTION PLATING WORKS, Inc.

LEBANON, OHIO

1897 1959

PIPE STOPPERS OF ALL KINDS

SAFETY GAS MAIN STOPPER CO. INC.

GOODMAN GAS MAIN STOPPER — USED SINCE 1897 — 2" HANDLE & LOCKING SLEEVE

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issuing any permanent certificate for new natural gas sales where prices are above existing rates.

An alternative would be to issue temporary certificates while conducting the studies. But this practice has been under considerable fire lately, and probably won't be used often.

This is the way Washington gas industry attorneys sum up the effects of the U. S. Supreme Court decision in the CATCO case.

The high court nullified Federal Power Commission approval of a gas supply contract between the CATCO group of gas suppliers and Tennessee Gas Transmission Co. It sent the case back to the FPC for additional hearings on the initial rate with the admonition that it be particularly careful in approving rates in initial contracts. Correction of inequities takes a long time and there are no refunds, the Court decision, written by Justice Tom Clark, noted.

The contract as finally approved by FPC would have given the CATCO group of producers 22.4 cents per Mcf, including tax. Tennessee previously had paid no more than 18 cents per Mcf in the same area. The gas is to come out of 17 of some 900 blocks of 5000 acres each from the offshore areas of the Gulf of Mexico.

Justice Clark said the FPC does not have to determine the reasonableness of initial rates in all certificate cases involving producer-pipeline contracts.

But he noted that "where the application (for a certificate) on its face or on presentation of evidence signals the existence of a situation that probably would not be in the public interest, a permanent certificate should not be issued."

In this case, because of the tremendous potential of the offshore gas producing area, the initial price set in the CATCO case will become a floor for future contracts in the area, he said. "New price plateaus will thus be created as new contracts are made, and unless controlled will result in 'exploitation' at the expense of the consumer, who eventually pays for the increases in his monthly bill," he added.

Producer proposals for sales "must be supported by evidence showing their necessity to 'the present or future public convenience and necessity' before permanent certificates are issued," the opinion instructs the FPC.

Justice Clark pointed out that the FPC may condition certificates in any manner. Price could be a condition, he said, "where the proposed price is not in keeping with the public interest because it is out of line or because its approval might result in a triggering of general price rises or an increase in the applicant's existing rates by reason of 'favored nation' clauses or otherwise."

Conditioning a certificate upon an initial price would not encroach upon the initial rate-making privileges allowed natural gas companies, he said.

It is "merely the exercise of that duty imposed on the commission to protect the public interest in determining whether the issuance of the certificate is required by the public convenience and necessity."

When the producers and the pipeline originally proposed the 22.4-cent rate, the FPC balked. It attempted to condition the certificate to a 17-cent rate with producers granted the right to file later for increases to the higher rate after deliveries began.

But the producers refused to accept the condition, threatened to withdraw the supplies they offered. The FPC later backed down and approved the higher rate. An appeals court later upheld the original FPC finding that there was lack of evidence to show the higher rate was reasonable. It also criticized the threat of the producers to withdraw their offer of the gas.

The CATCO group began deliveries to Tennessee this June.

One possibility after the high court decision was for the CATCO group—now without valid certificates to sell gas—to ask for temporary certificates to continue their sales. Such certificates in general have been under fire in Congress. And Justice Clark in his opinion noted that there was no evidence that the Tennessee Gas customers are "greatly in need of increased supplies of gas," on which the FPC based its approval. ■

HOW THE ARROW IS CUTTING COSTS FOR SERVICE CUTS

GAS COMPANIES *in all parts of the country* are realizing substantial savings in making service cuts by using the ARROW Mobile Hydraulic Hammer. One man and an ARROW can do the work of six men using air tools to break concrete, cut asphalt or compact trench backfill... and the ARROW does the job better.

Hydraulically controlled striking power—
The operator of the ARROW Mobile Hydraulic Hammer can set the hammer control upon automatic to deliver blows of uniform impact, up to 8,000 ft.-lbs. Or he can control the hammer manually. Also, he can use the exclusive ARROW creeper-gear to move the machine at uniform speed up to 32 ft. per min. A wide range of quickly interchangeable hammer points and tools makes the ARROW ideal for a wide variety of jobs. The ARROW is constructed to give years of rugged service under constant pounding.

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A special punch attachment is widely used with the ARROW for making small diameter test holes for locating gas leaks. It quickly penetrates blacktop or concrete, making test holes many times faster than hand operated air tools.

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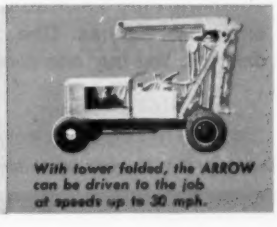

With tower folded, the ARROW can be driven to the job at speeds up to 30 mph.

Lawrence Gas Co. . . .

(*Continued from page* 73)

in the task of overhauling our 100 year-old distribution system to the point where we can adequately handle maximum hourly loads that will be 365 per cent greater in 1976-77 than in 1956-57.

Our present thinking regarding the composition of our distribution system in 1976 is shown in *Fig. 3.* In the 18 years prior to 1976 we expect to add six more regulator stations in specific areas. The open-end boosted pressure feeder main to Andover will have been converted to a conventional medium pressure feeder main, with provisions for adding regulator stations in south Lawrence if necessary. We also expect to convert six sections in Andover and Methuen from low pressure to medium pressure gas, and to install another main across the Merrimac river —thus providing reinforcement for sections of Andover and Methuen which have a high potential for real estate development.

The foregoing is a brief attempt at outlining the nature and extent of the major additions and improvements which are scheduled for the Lawrence Gas Co.'s distribution system. Also scheduled are many main replacements, tying together of dead ends, and paralleling of existing mains.

Our distribution system will thus ultimately consist of a low pressure system adjacent to the gas plant, with a medium pressure system on the outlying fringes of our territory. This will enable us to convert our medium pressure feeder mains to high pressure and extend them to the fringes of our franchise area. By installing pounds-to-pounds regulator stations off these new high pressure mains we will be able to reinforce our medium pressure network. We have attempted to develop a master plan which has sufficient flexibility to ensure its adaptability to many situations. Once again, only by careful study and constant review will we be able to obtain optimum efficiency from our master plan. (As a matter of interest, the Lawrence Gas Co.'s plan was developed prior to the acquisition of a McIlroy Fluid Network Analyzer, a joint effort involving Tufts College and 17 Massachusetts gas companies. The McIlroy Fluid Network Analyzer has since been used extensively in developing the master plans for other companies in the New England Electric System gas division.)

It might be well at this point to briefly consider our production facilities and the part played by these facilities in the design of our "optimum" distribution system.

At the time of conversion to natural gas in 1952, an economic study was made of our generating facilities. It was decided that we would convert one of our carburetted water gas sets to a hi-Btu oil gas set, using light gas oil, and that we would retain

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our low pressure LP-air gas plant, a jet plant supplied by three 30,000-gal. storage tanks.

This gave us ample generating capacity for several years, both for peak shaving and for emergency standby. In more recent years it became apparent that we would ultimately face a serious problem in attempting to distribute our low pressure oil gas and/or LP-air gas to our distribution system at the required operating pressures.

All produced gas is normally mixed with varying proportions of natural gas prior to being pumped into our storage holders. In the past the mixed gas was withdrawn from the storage holders and fed into the Andover and/or Methuen boosted pressure feeder mains by means of turbine-driven blowers. Our gas loads increased to such an extent that the plant pressure on these boosted-pressure feeder mains was rapidly approaching the maximum rated operating pressure of the blowers.

It was rather evident that we would soon have to cope with certain difficulties in attempting to properly distribute the volumes of peak shaving gas that would be required in subsequent years. Since only 35 per cent of our total load is distributed from the gas plant as low pressure gas, and since we desire to control the Btu and specific gravity of our sendout gas within optimum tolerable limits, provisions had to be made for instituting certain remedial measures.

A detailed engineering study is in process at the present time. This study is concerned with the economic feasibility of several alternatives:

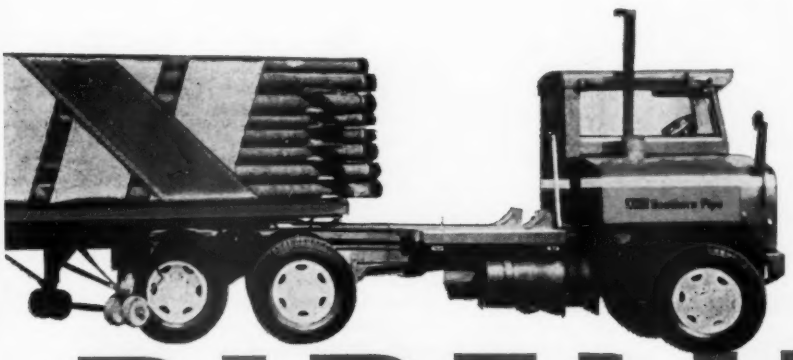
1) Should we increase or decrease the investment in our oil gas generating plant, bearing in mind the resultant effect on taxes, maintenance, and operating costs for auxiliary equipment such as condensers, relief holders, washer cooler, purifiers, tar separators, etc?

2) Should we increase our LP storage facilities and convert our LP-air gas low pressure jet plant to a high pressure plant, or,

3) Should we increase our LP storage facilities, increase the capacity of our low pressure LP-air gas jet plant, and install compressors which would be capable of taking low pressure gas and delivering it to our "ultimate" distribution system at whatever pressures may be required in subsequent years?

Certain combinations of these three alternatives are also possible. We are still in the process of evaluating data and have not yet reached the point where a decision can be made regarding the optimum course to follow.

Increased loads have squeezed company production and distribution facilities to the point where it is necessary to develop long-range plans that will enable us to successfully overcome the obstacles that will present themselves in future years. We have accepted the challenge because of a firm belief in the dynamic growth potential of our industry. ■



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GAS·PEOPLE

E. H. Tollefson
Consolidated

Joseph G. Burns
Michigan

W. M. Harcum
Robertshaw

George Revesz
Robertshaw

E. H. TOLLEFSON has been elected president and chief operating officer of Consolidated Natural Gas Co. He succeeds JAMES COMERFORD, president since 1955. Comerford was named chairman of the board and continues as its chief executive officer. Tollefson has been executive vice president.

JOSEPH G. BURNS is now executive assistant in Michigan Consolidated Gas Co.'s sales department. A 32-year veteran with the Detroit-based company, Burns has been superintendent of the customer service department for the past several years.

Connecticut Light & Power Co., Berlin, has made several appointments. W. LINDSAY BOOTH is now executive assistant to the vice president in charge of administration. His former post of manager of East Hampton is being filled by C. MARVIN CURTIS. FREDERICK W. RIGGS, industrial sales engineer at Essex, succeeds Curtis as manager at Glastonbury. TRAVER L. BERRY has been elected controller of the company. He joined CL&P in 1954 as assistant controller. CARL R. LARSON, staff assistant at the company's general headquarters, has been promoted to the new post of Berlin building manager.

WILLIAM M. HARCUM is general manager of Robertshaw - Fulton Controls Co.'s eastern research center, presently located in Philadelphia but slated to move to a new building nearing completion at King of Prussia, Pa. Harcum replaces RALPH V. COLES, now general manager, European operations, with offices in London. GEORGE REVESZ, former head of electricity and electronics department, is technical director of the research center.

CHARLEY LOCKHART has been appointed as associate for water chiller equipment in Texas by Arkla Air Conditioning Corp. He headquarters in Dallas.

WILLIAM J. AUGER is sales promotion manager for D. W. Onan & Sons Inc., Minneapolis. The appointment is part of the move to separate advertising and sales promotion. GEORGE BURDA, former head of advertising and sales promotion, is advertising manager.

Continued on page 102

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Malleable Couplings

Normac Insulating Malleable Couplings and fittings are available with polyethylene inserts and semi-insulating gaskets or full insulating rubber gaskets.

Insulating Couplings AND Fittings

Malleable Service Ell

The insulating principle depicted above is carried out in all Normac Ells and Tees.

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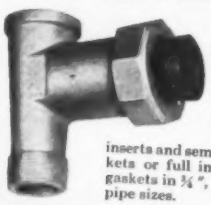
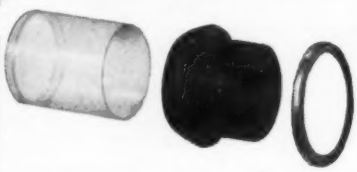
Brass Fittings



Normac insulating Brass compression end Tees, Ells and all compression end fittings are available with polyethylene inserts and semi-insulating gaskets or full insulating rubber gaskets in ¾", 1" and 1¼" iron pipe sizes.

Insulating Gaskets



The Normac insulating principle incorporates an efficient combination of a polyethylene sleeve and a semi-insulating gasket or full rubber gasket and retainer ring.

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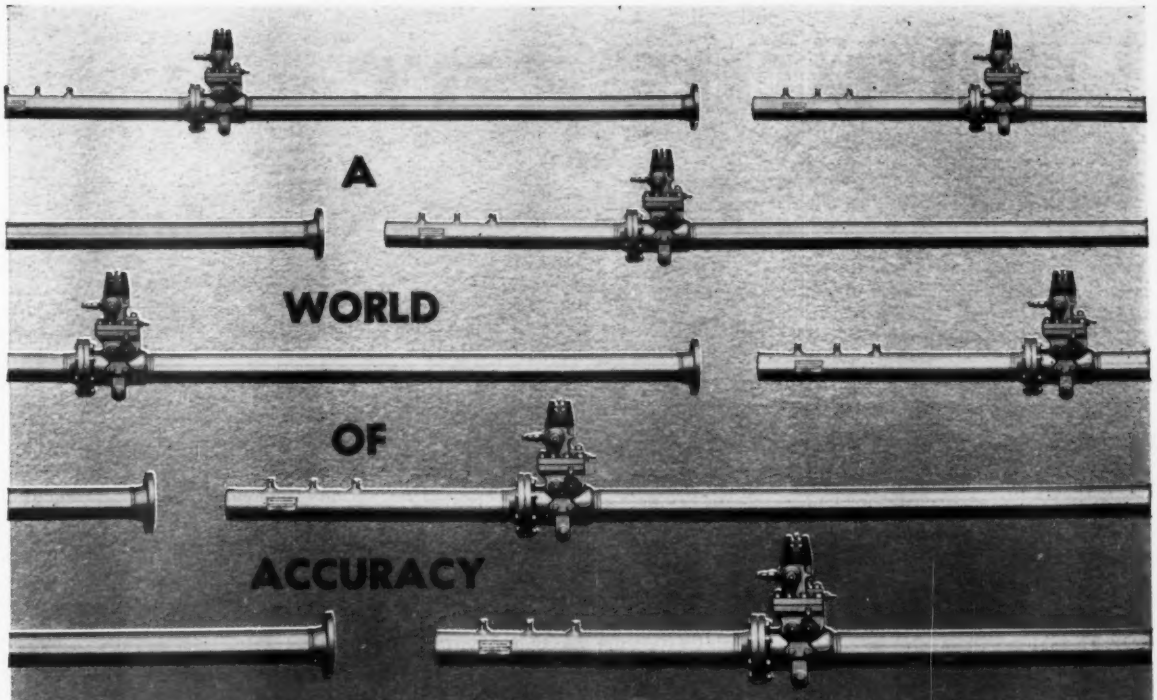

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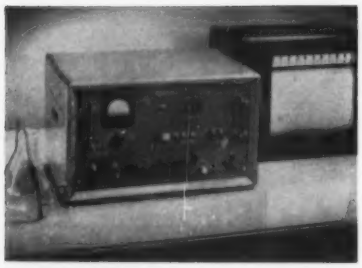
GAS DIGEST

New Products and Trade Literature

For more data on any of these items use the Readers' Service Card on pages 99, 100



1. Corrosion

Automatic corrosion measurements are possible with a new servo-controlled Corrosometer. Model L-2 detects as little as one millionth of an inch of corrosion on a routine basis and 1 billionth of an inch in some special applications. It automatically "tracks" corrosion as it occurs, providing a permanent record of the total thickness of metal corroded.
Crest Instrument Div.

2. Spherical-type valves

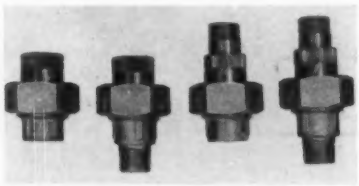
Full - opening, spherical - type valves from Rockwell are particularly suitable for gas lines. The Hypresphere valves are of carbon steel and have only four main parts: operating stem, ball plug, two spherical ring seats, and the body housing. Only the operating stem and ball plug are moving parts.
Rockwell Manufacturing Co.

3. Tape coating

Polyken has released an extra-strength protective tape coating for transmission lines. High density polyethylene protective coating No. 960 requires no primer, no drying or cooling time. In addition, it doesn't give off fumes, doesn't cause fire hazards, and provides low installation cost. It is applied by tensioned-spindle equipment.
Polyken Sales Div.

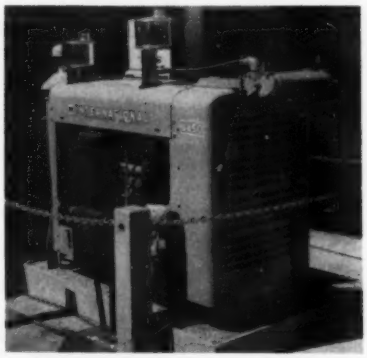
4. Duct sizing

Circular slide rule for sizing residential heating and/or cooling air distribution systems has been developed by American Standard. The Ductomatic can be used for designing new installations or checking out existing systems.
American Standard



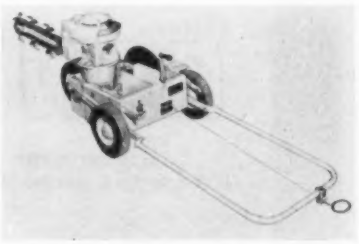
5. Insulated unions

The complete line of Wedgeseal insulated unions for gas service is available in any combination of female or threaded ends in ⅜, ¾, 1, and 1¼-in. sizes. These new unions end electrolytic corrosion of mains and services by providing completely effective protection from induced or stray house current.
Eclipse Fuel Engineering Co.



6. Automatic engine

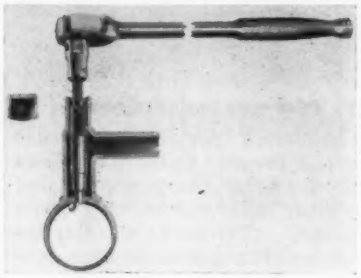
IHC's U-450 engine is automatically controlled to start, accelerate, stop and engage a clutch, throttle or choke. The six-cylinder unit develops 134 maximum hp at 2200 rpm. The "educated" engine can be started by a beam of light, moisture in the ground, radio signal, time clock, or liquid levels or pressures.
International Harvester Co.



7. Portable trencher

The Davis Pup is especially designed to prepare trenches for gas lines from the main to a building,

and for installing outside gas lights. The portable, self-propelled machine trenches from 2 in. to 3 in. wide and to depths of 3 ft. Once the trencher is started, no operator is needed except for casual observation and to stop the unit.
Davis Manufacturing Inc.



8. "Punch-It" tee

M. B. Skinner has a new quick, safe welding tee that incorporates in each tee a punch and positive shutoff. Punch size is $\frac{3}{8}$ in. or smaller. Also available is a model for use with saddles, threaded at the base to screw into the saddle. Each tee is tested to 5000 psi hydraulic pressure.
M. B. Skinner Co.

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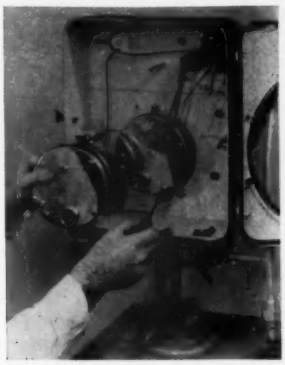
9. Gas cleaner

A new gas cleaner handles high volumes and extreme turndowns in gas flow in the removal of mechanically entrained dust and oil regardless of load. The Blaw-Knox Multi-Phase unit provides these results because it has more phases of scrubbing and separation than previous types. Improvements are accomplished by internal changes which insure (1) more and better contact of the gas with the scrubbing medium; (2) additional and improved separation of the liquid from the gas; and (3) internal control of the amount of scrubbing medium in circulation in proportion to the gas flow.
Blaw-Knox Co.



10. Gas drive

Rockwell's gas-driven chart drive is said to operate indefinitely and without attention as long as gas pressure is available. It is a completely self-contained air- or gas-powered instrument drive and timing unit. It provides power for operation of recording charts in many instruments, including orifice meters, gas lift intermitters, pressure recorders, and temperature gauges.
Rockwell Manufacturing Co.

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11. Microwave carrier

A new 24-channel FM carrier system for channelizing microwave radio communications link has been introduced by Raytheon. The B-640 multiplex carrier features transmitter crystal-control, miniaturized plug-in assembly, and full compatibility with telephone transmission standards.
Raytheon Co.

---

12. Pipe sealant tape

A chemically inert tape seals and permanently lubricates pipe joints. This unfused film tape, Scotch brand No. 547, can be applied in seconds. It conforms to all types of pipe threads and fittings. The tape's anti-sticking characteristics lubricate joints so they can be loosened and detached years after they are taped.
Minnesota Mining

---

13. Valve protectors

A new line of valve trim and diaphragm protectors, the Chem-Line, is available. Chief feature is the use of polyvinyl chloride for all normally wetted parts. In adapting PVC to the protectors, Lonergan supplies the parts normally wetted by the contained fluid in PVC. Other parts are of normal materials. The line is furnished on a special application basis to gas distribution systems.
J. E. Lonergan Co.

---

14. Lock-type line cap

Dresser's new lock-type line cap provides a safer, more rugged leakproof seal. Danger of pull-out is minimized. With its special lock-type gasket with steel beading, the Style 90 line cap resists longitudinal stress far in excess of conditions normally found in gas service piping.
Dresser Manufacturing Div.

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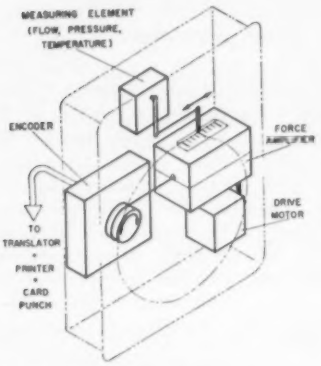
15. Trencher

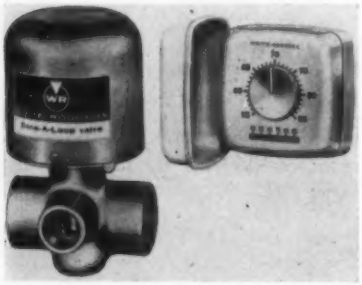
Auburn's Gear-Draulic trencher is for use with IHC 340 and 460 utility tractors. Widths from 6 to 14 in. and depths to 6 ft are dug by the trencher. It will dig up to 800 ft of trench per hr. Variable hydraulic drive automatically adjusts the forward speed to chang-

ing soil conditions for smooth trenching.
Auburn Machine Works



16. Digital transducer

The new Series 400 American digital transducer measures process variables and provides digital encoding for flow, liquid level, pressure or temperature. The Series 400 is available in vacuum and pressure ranges to 10,000 psi, temperature ranges to 600 deg F, and in mercury or bellows type manometers for liquid level or flow uses. Housing is standard all-weather meter cases.
American Meter Co.

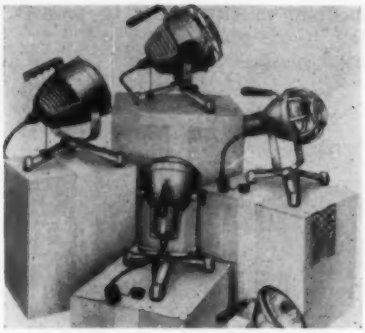


17. Zone control

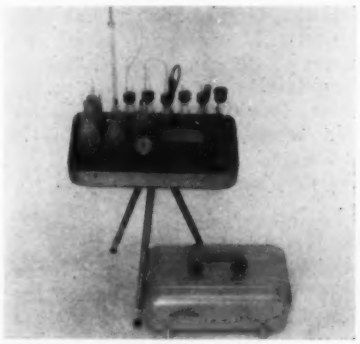
Zone-A-Loop is an economical zone control package for single-pipe hot water heating systems. It is designed for use with either new or existing systems. While providing all the advantages of zoning, the system reduces installation costs with simplified components and low-voltage wiring. Each zone is equipped with a low-voltage Fashion thermostat and Zone - A - Loop automatic water valve.
White-Rodgers Co.

18. Emergency floodlights

A complete line of emergency floodlights is available from Stonco Electric. The line ranges from a



rugged 500-watt portable producing 121,500 candlepower for big-power jobs to a 1¼-lb, 150-watt unit for all-around use. Included is a vapor-tight portable. Lights adjust easily for any position and are equipped with large aluminum positioning knobs for focus lock-in at any angle.
Stonco Electric Products

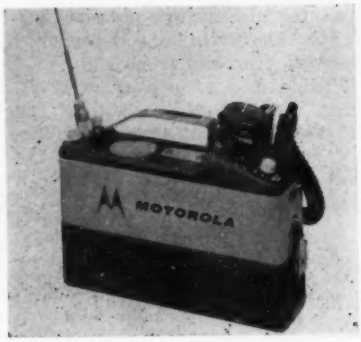


19. Gas analysis

Convenient and rapid gas analysis in the field and lab is possible with a new portable electrolytic titration instrument. Simplicity of operation makes the I-Br 313 Gas Titrator adaptable to use by both technical and nontechnical people. The instrument is particularly useful for measuring the concentration of hydrogen sulfide and organic sulfur compounds in natural and LP gas.
Robert R. Austin Laboratories

20. Tone decoder

A new tone decoder provides up to 31 momentary outputs from 5 audio frequency tone signals—or 63 momentary outputs using 6 frequencies. Extending functions almost 13-fold makes possible control of telemetering operations far beyond the capabilities of the usual straight-tone system using a single pair of wires.
Hammarlund Manufacturing Co.



21. Two-way radio-phone

Motorola's portable tone-coded squelch two-way radiophone blocks out annoying interference caused by other radio systems on a user's channel. "Private-Line" Handie-Talkie unit provides the same protection from local and long-range skip interference as the company's Private Line mobile and base station equipment.
Motorola Inc.

22. Ranges

Brown Stove Works' Featuramic styling, introduced earlier in its 36-in. range line, is now available on 30- and 20-in. sizes as well. The line is highlighted by the Touch O' Gold pedestal-type backguard with fluorescent lighting and "spill-free" top. Also featured is the Eze-Kleen roaster-broiler, which lifts right out for easy cleaning or double duty in oven as roaster.
Brown Stove Works

23. Light-haul truck

A dozen major improvements are featured in Cushman's 780 Truckster. The gasoline-powered truck can handle 800-lb payloads at an operating cost of less than a penny per mile. It is powered by a 7.95-hp Cushman Husky 4-cycle high compression engine.
Cushman Motors

FOR MORE INFORMATION

about New Products in this Issue . . . . .

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24. Clay spade

Davey Compressor has a new heavy duty clay spade. Davey-Holman Model 101 is said to be highly efficient for excavating stiff clay and hard pan as well as shale. When equipped with an extended shaft and T handle, it is suitable for use as a trench digger.
Davey Compressor Co.

TRADE LITERATURE

25. Gas air conditioning

A 38-page booklet, "Gas Air Conditioning: A Detailed Study of One Program Dedicated to the Elimination of the Summer Valley," has been prepared by Arkla. One gas company's air conditioning sales program is described in detail. It tells how the company boosted unit volume several hundred per cent in a single year.
Arkla Air Conditioning

26. Product catalog

"Better Tomorrows Begin Today at Allis-Chalmers" is a 32-page color booklet describing facilities and products made in each of the company's works. Presented are capsule facts about power generating and electrical transmission and distribution equipment, processing machinery, research and development.
Allis-Chalmers Mfg. Co.

27. Small computer use

A paper by the senior research physicist at the Research & Development Laboratories of the Portland Cement Association describes the problems that led to the acquisition of a small digital computer (Royal Precision LGP-30). The paper (S-509) also tells the uses to which the laboratory has put the machine and the benefits derived.
Royal McBee Corp.

28. Field compressors

Three bulletins from Clark describe the company's field compressors. Bulletin 171 covers Model CFB, a two-cylinder, heavy-duty addition. Model CFA packaged field compressor line is covered in Bulletin 158. This line is composed of two and four compressor cylinder models built in a total of 15 sizes ranging from 100 to 350 bhp. Bulletin 157 presents the Series HMB and TMB packaged compressors for gas field applications.
Clark Bros. Co.

29. Microwave

General Electric's Dual-Beam microwave equipment is described in Bulletin ECM 91. It tells how the Dual-Beam concept offers additional protection against unpredictable communication failures by exceeding techniques usually found in automatic standby equipment.
General Electric

30. Water heater control

The new 200R Unitrol gas water heater control is described and illustrated in a new publication. The new control, featuring built-in pressure regulator, has a slip-off cover, concealing gas cock and reset pushbutton.
Grayson Controls Div.

31. Alloy studs and nuts

A new 4-page, 2-color folder describes Republic Steel alloy studs and high carbon hex nuts. Physical characteristics are listed with information on standard, special, and stainless steel grades.
Republic Steel Corp.

32. Gas valves

Silent Knight gas valves are described in a six-page folder. The new folder (R-1635) lists the types of Silent Knight valves available, describing the job each was designed to do.
White-Rodgers Co.

33. Corrosion

Corrosion Services Inc. has published a condensed catalog covering its cathodic protection services and materials. Discussed are engineering and installation services as well as rectifiers, anodes and backfill, cables and accessories, insulation and coating materials, and instruments.
Corrosion Services Inc.

34. Pipe clamps

Two 4-page catalogs from Marman describe the company's pipe clamps. The Universal Patchmaster stops leaks on low and high pressure pipe with a synthetic rubber pad. The Universal Flagmaster features a reusable "flag" that attaches to the stainless steel strap.
Marman Division

35. Pipe cost savings

Four-way savings obtainable by using lightweight carbon steel piping are outlined in Bulletin TT942, "Fittings and Flanges for Light Weight Piping." Advantages of using the lightweight piping in gas distribution lines are discussed and illustrated.
Tube Turns

36. Rigid plastic pipe

"Be Absolutely Sure With ABS Plastics" is the title of a folder issued by Marbon Chemical. Presented are the advantages of using ABS pipe in the gas industry.
Marbon Chemicals Div.

37. Rotary compressor

New features of Ingersoll-Rand's recently introduced 125-cfm Gyro-Flo portable rotary compressor are presented in illustrated literature.
Ingersoll-Rand Co.

38. Tape transport

Available from Burroughs' ElectroData division is a 4-page brochure describing the Burroughs Model 546 magnetic tape transport. The unit is for use with digital computer and control systems.
Burroughs Corp.

39. Inhalation therapy

A 12-page booklet describes equipment and techniques for use during industry's "most urgent emergency"—the interruption of a worker's breathing. It was prepared for plant physicians, safety directors, first-aid groups, and personnel management.
National Cylinder Gas

40. Data processing manual

The large-scale Univac 1105 data-processing system is the subject of a 55-page manual. The illustrated book explains the various components and features of the system.
Remington Rand

plastic pipe

snaked in at high speeds set by fast-digging Cleveland trenchers

2 or 3-inch plastic pipe can be joined and snaked into trench 18 inches wide, 2 to 4-feet deep, at rates of up to 3 miles per day. The speed at which trench can be opened generally determines the daily footage of pipe put in place.

Plastic pipe installers get the production they want with Cleveland's wide range of digging speeds—over 30 usable combinations of digging wheel and crawler speeds—non-slipping, power-saving digging speeds as high as 75 feet per minute.

For plastic pipe—for *every* kind of pipe—for *every* trenching requirement—for speed, dependability and economy—nothing digs trench like a Cleveland.

The CLEVELAND TRENCHER Co.

20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

people • *Continued*

from page 94

Newly elected officers of New Orleans (La.) Public Service Inc. are GEORGE S. DINWIDDIE, chairman of the board; GERALD L. ANDRUS, president; CLAYTON L. NAIRNE, executive vice president; PAUL F. HOOTS, vice president; and FRANCIS J. LABANCA, comptroller. At the time of his recent election, Dinwiddie was president, a post he held since 1951. Andrus, with NOPSI since 1928, has been vice president since 1952. Before becoming executive vice president, Nairne was vice president in charge of operations.

Rockwell Manufacturing Co., Pittsburgh, has announced several appointments. The newly formed governmental relations department is headed by I. C. ROWE, formerly corporate secretary. Changes in the advertising department include naming JOSEPH A. MARK advertising manager of the company's power tool divisions; W. RICHARD BLEICHNER, advertising manager, meter and valve and petroleum and industrial divisions; WALTER H. DOUGLASS JR., advertising manager, municipal and register divisions; and CLIFFORD A. THOMPSON, editor-in-chief of Rockwell's eight publications. Rockwell also announced the election of PAUL A. WICK as secretary. Formerly he was assistant to the president and assistant secretary. THOMAS F. HASKINS, supervisor of the accounts payable department, has been named senior buyer in the general purchasing department.

FRANK M. GIBBONS has joined Commonwealth Services Inc., New York, as supervision of Commonwealth's oil refining and petrochemical consulting activities. He will headquarter in Houston.

RICHARD W. TERBUSH has joined General Controls Co. advertising sales promotion department as assistant manager.

GEORGE W. MILLER is the newly elected treasurer of Philadelphia (Pa.) Electric Co. He succeeds C. WINNER, who has retired.

ALBERT L. WELDY is sales representative for the Birmingham sales district of American Meter Co. He will headquarter in Pompano Beach, Fla.

Adams®
–the most widely imitated pipe clamp in the industry!

Take a second look next time you buy pipe repair clamps . . . and remember this . . . *only genuine ADAMS*® pipe clamps offer you *all* these advantages:

- highest quality
- fastest installation
- surest seal
- longest life
- greatest re-use value

Genuine Adams® clamps are carefully constructed of the finest materials obtainable. They are painstakingly inspected and fully guaranteed as to quality of materials and workmanship in accordance with the Warranty printed in our literature and price lists.

That's why it will pay you to take a second look next time you buy pipe clamps . . . to *make sure you get genuine Adams*® . . . the quality clamp!

WRITE today for complete information.

MAKE SURE you get Genuine Adams® Clamps!
Look for the name "Adams" on the band and on the bolthead

Adams® PIPE REPAIR PRODUCTS

2453 Merced Avenue, P. O. Box 3367, South El Monte, Calif. • Eastern Warehouse: Columbia, Penna.

STOP H_2S CORROSION BEFORE IT STARTS!

The Connelly IRON SPONGE purification process at the well site removes hydrogen sulphide BEFORE the gas is piped to central processing. Thus, the cause of pipe line corrosion is eliminated because corrosive gas never enters the transmission lines. Additionally, Connelly IRON SPONGE eliminates the need for extreme close control. It operates with high efficiency at low or high pressures—absorbs more H_2S, gives longer service between foulings and is easily regenerated. If you have a purification problem check this MOST ECONOMICAL solution today. Write for Field Processing Bulletin #OG-7.

CONNELLY

Incorporated

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CHICAGO 8, ILLINOIS

Elizabeth, New Jersey

New production manager of Bridgeport Thermostat Division Robertshaw-Fulton Controls Co., Milford, Conn., is DONALD J. NEARY. He has been assistant production manager since 1953.

Several changes were made in the gas distribution department of Public Service Electric & Gas Co., Newark, N. J. HOWARD C. ROEMMELE moves to assistant to the general superintendent of distribution. JOSEPH S. HOPKINS succeeds Roemmele as division superintendent in the central division. Succeeding Hopkins as central division staff engineer is HAROLD W. WILSON. JOHN E. ALLEN, formerly district engineer, Orange - Montclair gas distribution district, succeeds Wilson as district superintendent in Plainfield.

United Gas Improvement Co., Philadelphia, has announced the following changes in its sales department: FRANK KRIZAN is air conditioning sales engineer, supervising air conditioning sales in all gas divisions except the Philadelphia Gas Works. WILLIAM W. WEILL succeeds Krizan as assistant to the manager of sales and public relations. Weill is succeeded as residential sales supervisor at the Lancaster County Gas division by ROBERT M. MIDDLETON, who has been a retail salesman in the Reading Gas division since 1953.

ERNEST H. FURSTENAU has been elected an assistant secretary of Robertshaw-Fulton Controls Co., Richmond, Va. He joined the company as tax accountant in 1949; became assistant treasurer in 1957.

J. Robert Delaney (left), manager of gas sales for Cincinnati (Ohio) Gas & Electric Co., is sworn in as president of the Cincinnati Optimist Club by past president, Clifford Dye. The Cincinnati club sends more than 50 boys to camp each summer.

AMERICAN®

AL-175

ALUMINUMCASE METERS

LIGHT WEIGHT AND RUGGED

Precision-built AL-175 Aluminumcase meters are unequalled for dependable, economical domestic service. American's quality features assure maximum accuracy from pilot load to full rated capacity. And these light weight A.G.A. Class 175 meters provide important economies in shipping, handling and setting costs.

- One-piece, die-cast aluminum alloy body.
- 3-Convolution, molded Duramic diaphragms.
- Leakproof grommet-type seals.
- Reinforced flag rods.
- Self-lubricating porous bronze bushings.
- Vented, plastic index box.
- Rated capacity 175 cfh of 0.60 sp. gr. gas at ½-inch w. c. differential. Working pressure 5 psi.

Ask your American representative for Bulletin 305.

AMERICAN® METER COMPANY

INCORPORATED (ESTABLISHED 1836)

General Offices: Philadelphia 16, Pa.
Sales Offices in Principal Cities

WILLIAM C. TERRY has retired as assistant to the president of Nashville (Tenn.) Gas Co. His successor is RICHARD L. HINCH, controller. Terry joined Nashville Gas in 1918 when it was known as Nashville Gas & Heating Co. He started as a meter reader; became assistant secretary in 1935, secretary-treasurer 10 years later. He took over as assistant to the president early this year.

Retirement of two department superintendents of Peoples Gas Light & Coke Co., Chicago, has resulted in several new appointments. GEORGE I. SIMPSON, superintendent of the general accounting department, is retiring after 51 years of service. GEORGE A. MORGAN, superintendent of market research, is ending 34 years of service. In a move to more closely integrate accounting functions, JOHN CARLSON, assistant budget director, was appointed chief accountant. JOHN J. O'CONNELL, supervisory statistical accountant, was named manager of the regulatory and statistical accounting department. JOSEPH P. THOMAS, administrative assistant in the office of the vice president and comptroller, becomes manager of the rates and markets department. JOHN CRUICKSHANK, supervisory general accountant, is superintendent of the general accounting department. JOHN F. THORNE, assistant superintendent of the general accounting department, and CARL J. DJERF, assistant superintendent of the statistical accounting department, will be administrative assistants on the staff of the vice president and comptroller. ARTHUR SKELTON, general superintendent of the methods and procedures department, assumes responsibility for the archives department.

ROBERT KYLE has been named general consultant by Commonwealth Services Inc., New York. He will specialize in operational and management studies.

JAMES A. RODGERS JR. is manager of the technical sales division of White-Rodgers Co., St. Louis. Rodgers formerly was a technical sales engineer.

JACK TROUT has been promoted to claims manager for Sherman Products Inc., Royal Oak, Mich. Prior to his promotion, Trout was assistant service manager.

IF YOU CUT LARGE DIAMETER PIPE...
YOU NEED THESE
New REED HINGED 4-WHEEL PIPE CUTTERS
Four sizes cover the range from 2½" to 12"

Users tell us these completely new cutters are so efficient they often "pay for themselves" through the savings in crew time on a half-dozen cuts. They are the first really practical tools for cutting off steel or cast iron pipe in sizes from 2½" to 12". You can, for example, cut 8" steel pipe completely off in less than five minutes.

Four wheel design requires minimum swing of handle—less digging in ditch work, easier "tight-corner" cuts.

Closed frame permits light weight with complete rigidity for better cutting.

4-point guide aligns the cutter on the pipe . . . assures perfect tracking and a right angle cut.

Reed Razor Blade wheels track perfectly, cut easily and roll down burr on steel pipe.

Unconditionally guaranteed to be the most efficient cutter you have ever used. Ask your jobber or write for literature.

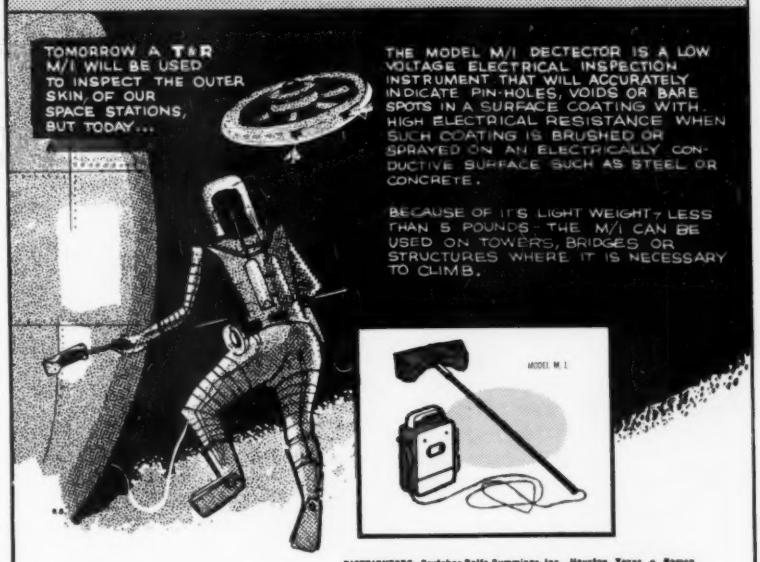
REED MANUFACTURING COMPANY
ERIE, PENNSYLVANIA • U. S. A.

DESTINATION: TOMORROW!

TOMORROW A T&R M/I WILL BE USED TO INSPECT THE OUTER SKIN OF OUR SPACE STATIONS, BUT TODAY...

THE MODEL M/I DECTECTOR IS A LOW VOLTAGE ELECTRICAL INSPECTION INSTRUMENT THAT WILL ACCURATELY INDICATE PIN-HOLES, VOIDS OR BARE SPOTS IN A SURFACE COATING WITH HIGH ELECTRICAL RESISTANCE WHEN SUCH COATING IS BRUSHED OR SPRAYED ON AN ELECTRICALLY CONDUCTIVE SURFACE SUCH AS STEEL OR CONCRETE.

BECAUSE OF ITS LIGHT WEIGHT - LESS THAN 5 POUNDS - THE M/I CAN BE USED ON TOWERS, BRIDGES OR STRUCTURES WHERE IT IS NECESSARY TO CLIMB.



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Electronic Detectors for every Industry
T&R TINKER & RASOR
417 AGOSTINO ROAD, P. O. BOX 281, SAN GABRIEL CALIFORNIA

for **leakproof, pressure-tight connections**

use **TiteSeal**®

SEALING COMPOUNDS

Heat and vibration-proof, non-solvent, will not shrink, crack or crumble. Makes all assemblies leak-proof and pressure-tight. Prevents rust, corrosion, joint seizure.

7 BASIC BLENDS

LIQUID WRENCH®

The super-penetrating rust solvent

LOOSENS

rusted bolts, nuts, screws, 'frozen' parts

Liquid Wrench works *fast*...yet is absolutely safe for all metals and alloys.

2171

At Industrial, Automotive, Hardware, Plumbing Jobbers

RADIATOR SPECIALTY CO.

Charlotte, North Carolina

SOLDER SEAL

A

BILLION

cu. ft.

LEAK!

If all the leaks Southern Cross Foresters located and repaired in 1958 were combined the result would be a colossal *billion cu. ft. per hour* leak!

Vegetation Method, Safety and Combination Surveys by SCF will find your unaccounted-for. Fully equipped, thoroughly experienced repair crews will make your repairs without forcing you into costly build-up of equipment and personnel. We would like to tell you more.

SOUTHERN CROSS FORESTERS

Atlanta 6, Ga. ME 4-4227

H. G. Clifford
Con Edison

H. E. Woodworth
SoCounties

W. J. Altpeter
SoCounties

E. G. Croom
SoCounties

JOHN J. CRANE and HARVEY G. CLIFFORD have been elected assistant secretary and assistant treasurer, respectively, of Consolidated Edison Co. of New York.

CHARLES E. THOMAS is comptroller for City Gas Co., Miami, and internal auditor for both Dade Gas Co. and South Dade Gas Corp.

CARL B. MCLAUGHLIN, executive vice president since 1954, is now president of Tube Turns Plastics Inc., Louisville, Ky. He succeeds GEORGE O. BOOMER, now chairman of the executive committee. For 11 years prior to the formation of Tube Turns Plastics in 1954, McLaughlin headed the engineering service of Tube Turns Division.

FRANK A. SMITH is manager of the Atlanta, Ga., district sales office of Consolidated Electrodynamics Corp., Pasadena, Calif. He succeeds VINCENT M. MEAGHER JR., recently named CEC marketing manager for transducer products.

W. K. VENATTA has been named manager of Oronite Chemical Co.'s manufacturing department. Venatta, who will headquarter in San Francisco, has been manager of the company's Oak Point, La., plant for the past two years.

Several men have been promoted in Southern Counties Gas Co.'s general office sales department. W. J. ALTPETER was named to the new post of staff representative, builder promotion. Succeeding him as staff representative, appliance merchandising is E. G. CROOM. H. E. WOODWORTH succeeds Croom as coordinator, new construction promotion. Woodworth formerly was in the company's Harbor division sales department.

MARVIN E. WHITE has been promoted to industrial sales manager of Ohio Fuel Gas Co.'s Columbus district. He is succeeded as Athens district industrial sales manager by HAROLD R. ROHR.

ELMER W. CONE has been named sales agent for Kirk gas refrigerators for Kansas and western Missouri.

CARRINGTON MASON was elected vice president in charge of operations of Houston (Texas) Natural Gas Corp., succeeding the late E. S. George. Mason joined Houston Natural in 1949 as an industrial engineer, became acting general sales manager two years later, and executive assistant in 1952

Faster LOCATING!

LOWER SERVICE COSTS

with the improved AQUA VALVE BOX **LOCATOR!**

Your Name In Gold FREE!

$32.50 F.O.B Cin., Ohio

STOCK this useful tool for every service CAR and CALL

Speed Locating • Keep Customers Happy

- **NO WIRES, BATTERIES or SWITCHES**—simple, powerful magnetic action, factory adjusted to YOUR geographical location assures unfailing results!
- **NO NEEDLE SPINNING**—exclusive electric braking action saves you time!
- **NO STOOPING**—easy top-view reading!
- **RUGGED**—compact, accurate, convenient!
- **GUARANTEED**—to function regardless of weather, surface or ground cover!
- **NATION'S MOST WIDELY USED LOCATOR!**
- **15-DAY FREE TRIAL**—No money! No obligation! You be the judge!

ORDER NOW - Wire or Call Kirby 1-4200 collect

AQUA SURVEY & INSTRUMENT CO.

2016 Leslie Ave., Cincinnati 12, Ohio

H. R. Rohr
Ohio Fuel

M. E. White
Ohio Fuel

EDWARD E. STEVENSON has been assigned to the general sales manager's staff of Peoples Natural Gas Co., Pittsburgh. Stevenson formerly was sales and service supervisor for the Pittsburgh division with headquarters in Wilkinsburg. He will be in charge of the company's gas appliance merchandising activities with department stores throughout the Pittsburgh area.

J. EDWARD ASHWORTH has joined Commonwealth Services Inc. as a general consultant in the Houston office.

As part of its reorganization program, Elizabethtown Consolidated Gas Co., Elizabeth, N. J., has elected the following officers: HENRY ROHRS, executive vice president; GEORGE COON, vice president, operations; JOHN J. CRILLY, assistant vice president, operations; WILLIAM T. POTTER, vice president, accounting and commercial; JOHN KEAN, vice president, sales and public relations; and HARRY L. GRAHAM, treasurer. W. S. POTTER is president and chief executive officer of the company. Rohrs, with the company since 1930, has been vice president and treasurer since 1950. Coon has served as chief engineer since last year. Crilly, with Elizabethtown for 49 years, has been superintendent of production since 1935.

A. P. Smith Manufacturing Co., East Orange, N. J., has promoted JERRY CAPRIO to manager of engineering and JOHN STEINEBACH to assistant plant superintendent.

New technical service director for Girdler Catalysts, Louisville, Ky., is DUANE W. ALLEN . . . JOHN W. BENSON was promoted to assistant national advertising manager, RCA-Whirlpool major home appliances. He succeeds JOHN TRUX . . . Caloric Appliance Corp. named F. H. MOORE sales representative for the state of Georgia.

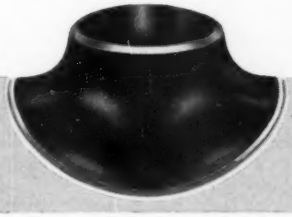
WRITE FOR CATALOG S-1

BONNEY

BONNEY SWEEPOLETS®

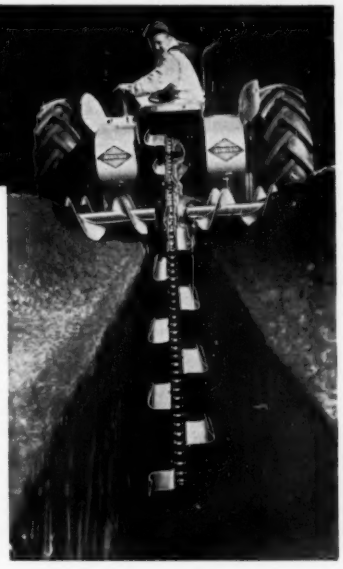
Pat. Pend.

. . . are SWEEPING the pipeline industry



BONNEY FORGE AND TOOL WORKS
ALLENTOWN, PA.

CUT THE COST OF DITCHING WITH AUBURN TRENCHERS



You get more trench for your money – day in and day out – and at less cost with an **Auburn**. Thousands of **Auburn** owners have proved it. The Auburn has low initial cost. It's virtually trouble-free; works in soil where others can't; and, it requires only one man to operate it. The **Auburn** is rugged, but simple in design. It has fewer moving parts, less chance to break down. A unique, variable speed drive automatically adjusts the speed to changing soil conditions, and it will dig up to 800 feet per hour. Trenches from 6 to 14 inches wide and down to 6 feet. Special bits are available for rock, shale, or frozen ground.

Auburn is the world's largest producers of trenchers.

AUBURN GEAR-DRAULIC

Tractor-mounted trenchers are available for M-F Work Bulls, IH Utility, John Deere Crawler and Wheel Industrial, and Ford Tractors.

Jeep-A-Trench GEAR-DRAULIC

the original Jeep-mounted trencher, and only trencher approved by Willys Motors. Available at Jeep Dealers.

Write for complete information and dealer's name

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AUBURN MACHINE WORKS, INC. AUBURN, NEBRASKA, U.S.A.

WARRENGAS
the Concentrated Fuel
GULF GULFTANE LP-GAS
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TULSA, OKLAHOMA
SALES OFFICES:
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NEW YORK, NEW YORK
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COLUMBIA, SOUTH CAROLINA
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LOS ANGELES, CALIFORNIA
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Modern Methods developed by HEATH give you new Safety Survey work to control leakage . . .

Mobile Infra-red analyzer (IR units) are used to make your Heath Leakage Control Survey more complete. New Auto-Test-Inserts ("A-T-I" units) used in downtown areas, further improve the Safety factor.

Write for information about Heath Surveys to meet your special needs.

The Safety Service That Saves Gas

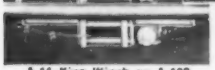
HEATH
Survey Consultants, Inc.
378 Washington St., Wellesley Hills 81, Massachusetts

Koenig ALL-STEEL SERVICE BODIES

Each body electrically welded into one unit with bed reinforced. Sturdy and economical . . . weatherproof compartments with recessed paddle-handle door locks.

Write for literature on service bodies, line-construction bodies, side boxes, and King Winches.

KING WINCHES



A-11 King Winch on A-120 (4 x 4) International truck. There's a front-mount King Winch designed to fit your specific needs . . . for ½-ton through 2½-ton trucks . . . pulling capacities of 8,000 to 19,000 lbs.

P.T.O.-driven King Winch on Willys Jeep FOR ALL WILLYS JEEPS, 4 WD TRUCKS AND 4 WD STATION WAGONS. Power-take-off-driven King Winch models 130J and 131J for CJ-3B and older-model Jeeps, can be transferred to CJ-5 and CJ-6 Jeeps . . . nothing extra needed.

King Winches for International trucks available through International dealers.

Koenig cabs and King Winches for Willys vehicles available through all Willys dealers.

Koenig IRON WORKS, INC.
P. O. BOX 7726 HOUSTON 7, TEXAS

PROTECT mains, meters, pipes, equipment, and appliances with
MAYCO
Dielectric Fittings or Dielectric Bushings

Stop electrolysis by insulating connections with MAYCO Dielectric Fittings or Dielectric Bushings. Bushings are toughest PLASKON nylon with extra-heavy "hex" gripping surface (on most sizes)...withstand pressures to 1000 lbs., temperatures to 300° F. Sizes to 2" for gas, plumbing, heating installations—wherever dissimilar metals are joined. Order from your jobber or write:

MAY PRODUCTS, INC.
GALESBURG, ILLINOIS
Manufacturers of MAYCO Dielectric Fittings – MAYCO Water Softeners

Deaths

ALLEN D. MACLEAN, chief engineer of the Superior Meter Co., died recently from a sudden heart ailment in Punxsutawney, Pa. A well-known and highly respected figure in the gas industry, Mr. MacLean was a creative and experienced engineer and the author of articles in past issues of GAS Magazine. He joined Superior Meter, Neptune Meter Co., subsidiary, in 1955 as chief products engineer. He became chief engineer in 1956. Before joining Superior, Mr. MacLean was chief products engineer of the Mueller Co., Decatur, Ill. In 1926, he joined Pittsburgh Equitable Meter Co. as chief engineer and was later made a vice president. He also was associated with Chaplin-Fulton Manufacturing Co.

LEO A. MAYO, controller of the Connecticut Light & Power Co. since 1954, died recently in Hartford. He began his utility career with the former Waterbury Gas Light Co., which became part of CL&P in 1931. He held posts as an auditor and purchasing agent and, in 1929, became supervisor of customer accounts. In 1951 he was named to the new post of director of methods. He was elected controller in 1954.

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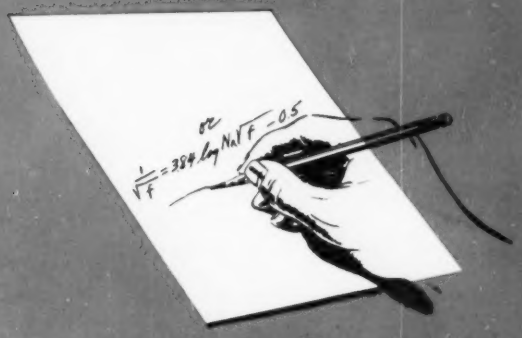
GAS

PIPELINE SECTION



PIPELINE FLOW TESTS

evaluate cleaning and internal coating

For the Pipeline Industry . . .

the big news for 1959 is

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JOHNS MANVILLE JM PRODUCTS

Pipeline flow tests

evaluate cleaning and internal coating

Initial tests on 24-in. line tend to prove value

By C. H. KLOHN • Tennessee Gas Pipeline Co.

Preface

A SERIES of flow tests was performed on an 11.896-mile section of 24-in. OD x .250-in. WT pipe. A range of flow rates was established, from 150 MMcfd to 450 MMcfd, in increments of approximately 50 MMcfd. The purpose of these tests was to discover if interior cleaning or interior coating had any effect upon the deliverability of a natural gas pipeline. This was a joint project, being conducted under the auspices, and with the financial assistance of the following organizations:

Texas Gas Transmission Co.
Lone Star Gas Co.
Transcontinental Gas Pipeline Co.
Humble Oil & Refining Co.
El Paso Natural Gas Co.
Trunkline Gas Co.
Coast Paint and Lacquer Co.
Pipe Cote Service Corp.
Northern Natural Gas Co.
Tennessee Gas Pipeline Co.

The section that was examined has been in normal continuous service in the Tennessee Gas Pipeline Co. system for 10 years. The downstream end is adjacent to measurement facilities previously used by the AGA in another, completely different project which required accurate gas measurement. This section had been placed in service after being cleaned by one wire-brush type pig. There had been no occasion to run any further cleaning pigs during the following years of service.

There is only a slight change in elevation between the upstream and downstream ends. The portion of pipeline contains 79 wrinkle bends, 81 per cent of which are between 4 and 6 degs. All of the gas passing through this section has been dehydrated, and a large portion has been processed by gasoline plants, which have removed the heavier hydrocarbons. It was necessary to install a 24-in. crossover to the inlet header at the measurement site. This crossover was teed at both ends and a 24-in. full opening valve was set in the crossover. It was also necessary to weld two taps in the transmission line for measurement of temperature and pressure. The taps were placed well away from the nearest fittings. The upstream tap was installed 50 ft downstream of some 16-in. crossover assemblies, and the downstream tap was set 32 ft upstream of the 24-in. crossover.

The project was organized in three phases:

Phase 1: The section was tested after 10 years operation.

Phase 2: The section was cleaned with two separately run wire brush type pigs. The section was tested after cleaning.

Phase 3: The section was cleaned and coated. Two wire brush type pigs were used in the cleaning, and then a 3000-gal. plug of methyl ethyl Ketone was used as a detergent. The line was then coated with an epoxy coating. The section was tested after coating.

It is well known that the present gas flow formulas are based upon certain premises which do not always occur. For use in the solution of the many and varied problems that arise in the operation or expansion of gas transmission facilities, the engineer must make an estimate of deliverability. To do this, he needs to know the limitations of the formulas and an accurate correction factor to correct for the inefficiency of the formula. To determine the feasibility of ammonia displacement as one of the ways this factor may be obtained, tests were performed in Phase 1 and Phase 3.

Summary

PIPELINE deliverability was increased by approximately 5 to 10 per cent depending upon the rate of flow. This is broken down to a nearly constant 4 per cent increase directly attributable to the cleaning operation of Phase 2 and an additional 1 to 6 per cent directly attributable to the work done in Phase 3.

Apparently, the test results of pipe in operational use are somewhat different than those obtained under laboratory conditions. A "practical" smooth pipe law to correct for this difference is suggested:

$$\frac{1}{\sqrt{f}} = 3.84 \log N_R \sqrt{f - .5}$$

The three most common flow equations used by the gas industry are the Weymouth, Panhandle A and Panhandle B. *Figs. 8, 9 and 10* are included in this article to illustrate the relative differences between the formulas. The deviation factor is present in the orifice meter calculations in *Figs. 8, 9 and 10,* but is not present in the Panhandle A or the Weymouth equations.

It is felt the results of the ammonia tests show that the calibration of the method depends upon the condition of the interior and the rate of flow. It also seems reasonable to assume that it is dependent upon distance. *Fig. 12* is a graph of the results of the ammonia tests. However, participants in the AGA NB-13 Pipeline Committee have concluded that the ammonia rates do not depend upon (a) interior pipe condition, (b) rate of flow, or (c) distance of ammonia travel.

Testing

• Procedure

A TEST consisted of reading deadweight gauges, barometers, gas flow temperatures, orifice meter chart differential, and atmospheric temperature every five minutes for a period of 20 minutes. From five minutes to an hour after the first five readings were complete, at least one more set of 5-minute readings were obtained as a check before changing the flow rate. High pressure water manometers were also read every five minutes during most of the tests as a check on the orifice meters.

Each of the figures in *Tables 1, 2 and 3* represents an average of the five 5-minute readings.

Specific gravity was obtained once during each flow rate using an ACME gravity balance. If the test period for a flow rate required longer than three hours, specific gravity was determined again. To examine the continuity of gas quality throughout the three phases, water dew point and hydrocarbon dew point were observed once during each flow rate. In addition, two gas samples were taken at random during each phase for analysis and deviation tests.

Tests of this type depend upon absolute control over the immediate area, and the cooperation of operating and testing personnel. This was accomplished by constant radio contact and periodic time checks to assure simultaneous readings at the separated locations.

• Establishing flow rate

Increasing the flow through the section over normal operational flow was accomplished by pinching or closing MLV 6-3 and/or MLV 6-1 (see *Fig. 1*). Decreasing to less than normal operation was accomplished by pinching the outlet valve at the measurement site. All crossovers were opened at MLV 5 and downstream crossovers were opened at MLV 6. Pinching or closing was done slowly in order to stabilize the immediate pipeline system more quickly. After the differential

TABLE 1 Summary Sheet—Phase 1

Test	Date	Starting Time	Remarks	P_1 PSIA	P_2 PSIA	dp_e	Qm MMcfd	G	T_1 °F	T_2 °F	Average $\frac{1}{z}$	f	Viscosity $M \times 10^6$	$N_R \times 10^{-3}$	$\sqrt{\frac{1}{f}}$	Darcy Coefficient f°
1-A	11- 3	1:55	—	731.17	713.56	0.30	191.06	.603	75	74.5	1.1074	.002552	7.90	8,560	19.80	.01021
1-AR		2:55	—	730.91	713.40	.30	191.18	.603	75	74.5	1.1074	.002533	7.90	8,566	19.86	.01013
1-B	11- 3	4:35	—	735.24	708.96	.29	235.16	.596	74.5	74.5	1.1030	.002549	7.90	10,414	19.81	.01019
1-BR		5:30	—	734.88	708.50	.29	235.99	.596	74.5	74.5	1.1030	.002539	7.90	10,451	19.85	.01015
1-C	11- 4	2:35	—	693.38	655.61	.27	274.20	.594	74	73	1.0967	.002525	7.80	12,257	19.90	.01010
1-CR		3:45	—	691.46	653.91	.27	273.38	.594	74	73	1.0967	.002519	7.80	12,221	19.92	.01007
1-CR1		4:25	—	691.40	653.57	.27	274.53	.594	74	73	1.0967	.002516	7.80	12,272	19.93	.01006
2-A	11- 5	1:10	—	714.08	656.10	.27	342.82	.595	74	73	1.0985	.002525	7.82	15,311	19.90	.01010
2-AR		1:50	—	713.19	654.91	.27	342.63	.595	74	73	1.0985	.002537	7.82	15,303	19.86	.01015
2-B	11- 5	4:05	—	719.64	645.19	.27	389.01	.595	73	72.8	1.0995	.002516	7.82	17,374	19.94	.01006
2-BR		4:35	—	719.13	644.86	.27	388.71	.595	73	72.8	1.0995	.002512	7.82	17,361	19.96	.01005
2-C	11- 6	1:50	—	730.83	639.62	.27	430.92	.597	74	72	1.0993	.002515	7.82	19,311	19.94	.01006
2-CR		2:20	—	730.32	638.90	.27	430.91	.597	74	72	1.0993	.002518	7.82	19,310	19.92	.01007
3-A	11- 7	11:10	—	731.33	716.78	.29	174.55	.596	74	74	1.1031	.002548	7.90	7,730	19.80	.01019
3-AR		12:20	—	731.47	716.91	.29	174.04	.596	74	74	1.1031	.002565	7.90	7,707	19.75	.01026

TABLE 2

Summary Sheet—Phase 2

Test	Date	Starting Time	Remarks	P_1 PSIA	P_2 PSIA	dp_o	Qm MMscfd	G	T_1 °F	T_2 °F	Average $\frac{1}{z}$	f	Viscosity $M \times 10^6$	$N_R \times 10^{-3}$	$\sqrt{\frac{1}{f}}$	Darcy Coefficient f°
1-A	11-17	11:35	—	736.39	720.04	.29	192.72	.597	74	75	1.1037	.002362	7.89	8,560	20.58	.009451
1-AR		12:10	—	736.55	720.24	.29	192.99	.597	74.5	75	1.1037	.002349	7.89	8,572	20.64	.009398
1-B	11-17	2:30	—	739.08	714.95	.29	237.87	.594	74.5	75	1.1037	.002309	7.90	10,499	20.81	.009236
1-BR		3:00	—	738.47	714.31	.29	238.00	.594	74.5	75	1.1037	.002308	7.90	10,504	20.82	.009229
1-C	11-17	5:15	—	742.59	706.62	.29	290.57	.598	75	73	1.1040	.002297	7.90	12,911	20.87	.009186
1-CR		5:40	—	742.77	706.30	.29	291.46	.598	75	73	1.1040	.002315	7.90	12,951	20.79	.009257
2-A	11-18	1:30	—	707.42	653.22	.27	346.89	.593	75	73	1.0977	.002293	7.82	15,443	20.89	.009171
2-AR		2:05	—	706.30	652.18	.27	346.61	.593	75	73	1.0977	.002290	7.82	15,429	20.90	.009158
2-B	11-18	4:15	—	708.66	640.07	.27	389.12	.593	75	72.5	1.0978	.002290	7.81	17,343	20.90	.009158
2-BR		4:45	—	708.41	639.62	.27	389.86	.593	75	72.5	1.0978	.002287	7.81	17,376	20.91	.009145
2-C	11-19	12:00	Very unstable	718.57	639.72	.27	423.02	.592	74	72.5	1.0985	.002251	7.81	18,822	21.08	.009005
2-CR		4:15	Very unstable	693.67	618.52	.26	405.22	.594	74	72	1.0944	.002244	7.78	18,161	21.11	.008975
2-CR1		4:40	Very unstable	692.15	617.09	.26	404.41	.594	74	72	1.0944	.002245	7.78	18,125	21.11	.008980
3-A	11-20	11:30	—	719.35	708.98	.29	148.87	.597	74	74	1.1017	.002435	7.88	6,621	20.27	.009740
3-AR		12:50	—	721.32	710.78	.29	151.47	.597	74	74	1.1017	.002398	7.88	6,736	20.42	.009592
3-AR1		1:20	—	721.23	710.77	.29	151.00	.597	74	74	1.1017	.002394	7.88	6,715	20.44	.009576

TABLE 3

Summary Sheet—Phase 3

Test	Date	Starting Time	Remarks	P_1 PSIA	P_2 PSIA	dp_o	Qm MMscfd	G	T_1 °F	T_2 °F	Average $\frac{1}{z}$	f	Viscosity $M \times 10^6$	$N_R \times 10^{-3}$	$\sqrt{\frac{1}{f}}$	Darcy Coefficient f°
1-A	12- 8	11:35	—	726.82	709.50	.29	202.82	.597	70	70	1.1067	.002256	7.85	9,054	21.05	.009024
1-AR		12:40	—	726.18	708.84	.29	203.16	.597	71	70	1.1067	.002247	7.85	9,069	21.10	.008987
1-AR1		1:15	—	726.05	708.57	.29	203.14	.597	70.5	70	1.1067	.002266	7.85	9,069	21.01	.009064
1-B	12- 8	3:15	—	728.67	705.34	.29	239.22	.597	71	70	1.1058	.002186	7.86	10,666	21.39	.008746
1-BR		4:10	—	728.46	704.83	.29	239.86	.597	70	69.5	1.1068	.002207	7.84	10,721	21.28	.008829
1-C	12- 9	11:40	—	731.88	696.98	.29	297.01	.597	70	69	1.1061	.002128	7.84	13,276	21.68	.008511
1-CR		12:25	—	731.49	696.12	.29	298.75	.597	70	69	1.1061	.002130	7.84	13,354	21.67	.008519
1-AR2	12- 9	4:35	—	723.79	706.92	.29	200.59	.593	70	69	1.1067	.002254	7.84	8,906	21.06	.009016
1-AR3		5:25	—	724.80	708.11	.29	200.52	.593	70	69	1.1067	.002234	7.84	8,903	21.16	.008937
1-AR4		5:50	—	725.22	708.55	.29	200.60	.593	70	69	1.1067	.002231	7.84	8,907	21.17	.008925
2-A	12-10	11:55	—	716.76	667.26	.29	350.48	.594	70	68	1.1027	.002111	7.78	15,708	21.76	.008442
2-AR		1:05	—	716.29	666.85	.29	350.40	.594	70	68	1.1027	.002108	7.78	15,704	21.78	.008430
2-B	12-10	3:05	—	720.30	661.16	.29	386.42	.594	70	68	1.1025	.002072	7.78	17,318	21.96	.008288
2-BR		4:10	—	720.35	660.80	.29	387.00	.594	70	68	1.1025	.002080	7.78	17,344	21.92	.008319
2-C	12-11	12:50	—	722.94	650.48	.28	428.20	.595	68	67.5	1.1033	.002060	7.77	19,248	22.03	.008242
2-CR		1:55	—	723.61	650.43	.28	431.49	.595	67	67.5	1.1045	.002054	7.76	19,421	22.06	.008218
2-D	12-11	4:05	—	731.00	640.68	.28	485.34	.595	68	67	1.1028	.002018	7.76	21,844	22.26	.008069
2-DR		5:05	—	731.08	639.93	.28	487.32	.595	69	67	1.1028	.001998	7.77	21,905	22.37	.007990
2-DR1		5:35	—	730.23	639.37	.28	486.03	.595	69	66.5	1.1028	.002001	7.77	21,847	22.35	.008002
3-A	12-12	12:10	—	724.43	712.50	.29	165.62	.595	68	69	1.1073	.002329	7.83	7,388	20.72	.009316
3-AR		1:00	—	725.09	713.11	.29	165.70	.595	68	69	1.1073	.002338	7.83	7,391	20.68	.009355
3-AR1		2:00	—	725.69	713.73	.29	165.74	.595	66	69	1.1085	.002342	7.82	7,402	20.66	.009371
3-AR2		2:40	—	725.95	713.98	.29	165.58	.595	68	69	1.1073	.002343	7.83	7,386	20.66	.009372
3-AR3		3:30	—	725.30	713.52	.29	165.00	.595	68	69	1.1073	.002320	7.83	7,360	20.76	.009277
3-AR4		3:55	—	725.17	713.41	.29	164.93	.595	68	69	1.1073	.002317	7.83	7,357	20.78	.009266

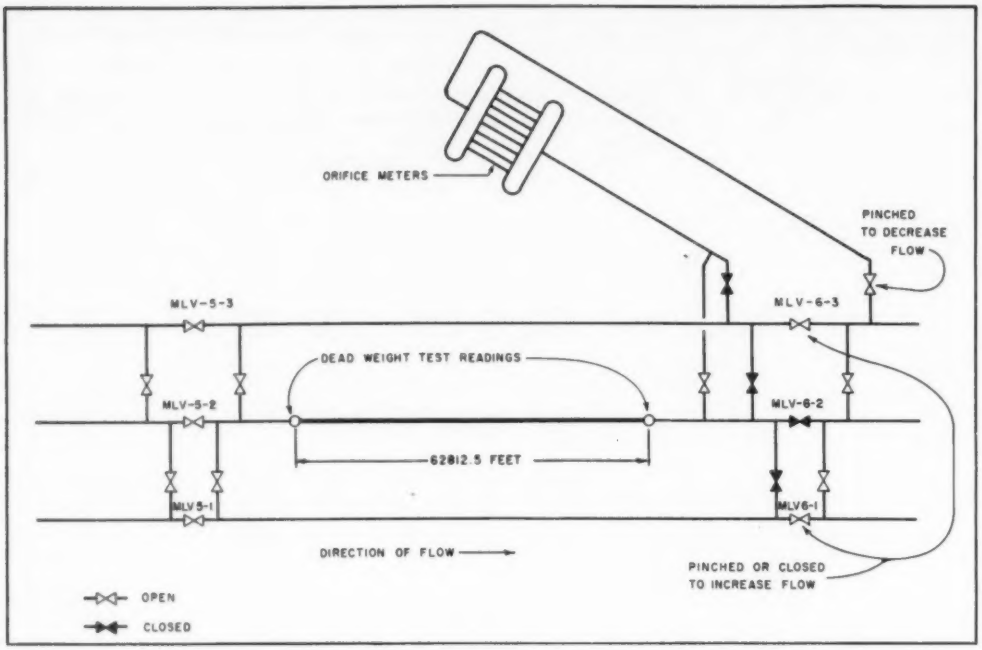


Fig. 1. Schematic of test area.

was stabilized (by observing orifice meter charts) an additional one to two hours was required for the pressures to stabilize.

• Definition of stabilization

The word stability, as used in this report, is subject to definition. Perfect stability (steady state) is next to impossible to attain in a transmission system, therefore arbitrary limitations were set on the amount of change of differential and pressure.

If orifice meter differential was changing at a rate of no more than 0.4 in. in 20 minutes, and pressures at MLV 5 and MLV 6 were changing at no more than 0.1 psi in 5 minutes, with the pipeline pressure differential remaining nearly constant, the line was considered stable, and testing was begun. During a few of the tests at the higher flow rates, these limitations were slightly exceeded.

The variations of pressure and differential were far below the arbitrary maximums during all of the tests at the lower flow rates. A forced change in gathering system operation produced a very high degree of instability during Phase 2. This occurred when trying to attain a rate of 450 MMcfd. The data taken during this instability are reproduced in *Table 2* for those who wish to treat it for confirmation of some of the published literature on transient flow.

Measurement of the Variables, Description and Discussion of Apparatus

• Gas measurement

FIGURE 1 shows a schematic of the test area. By pinching or closing the proper valves, the flow through the test section could be increased or decreased. Eight meter runs of 10.050-in. ID pipe were available for gas measurement. A 6.400-in. orifice plate was used in each of the runs throughout all of the tests. A

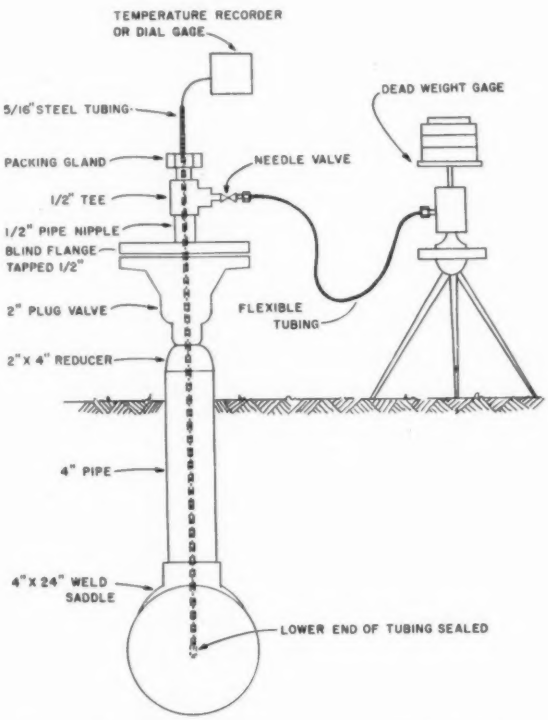


Fig. 2. Temperature and pressure measurement apparatus.

40-in. differential was arbitrarily selected as a necessary minimum in order to maintain a high degree of accuracy in the measurement calculations. These considerations determined the number of runs to put in service for any given flow rate.

The inlets and outlets of the meter runs are manifolded to "doughnut" headers. This type of piping arrangement is probably the best practical way to attain a flow distribution closest to equality. For calculations, orifice meter differential was read from the charts and pressure was read by dead weight gauge. Gas temperature was taken by thermometer in mercury filled thermowell located a few feet downstream of one of the orifice fittings.

High pressure water manometers were filled with distilled water and colored with a liquid of specific gravity equal to 1.00, or were filled with a colored oil of specific gravity equal to 1.00. Standard maintenance procedures were applied to all measurement equipment.

• Pressure

All pressures were determined with dead weight gauges. These gauges were checked and calibrated by the manufacturer just prior to the tests. However, the manufacturer's oil was removed and a lighter (20W) oil substituted to attain better sensitivity in the cool weather encountered. The dead weights were then calibrated against each other. This was done three times during the tests, and no corrective measures were necessary.

PRODUCER: T.G.T. ANALYSIS DATE: 12-2-53

LOCATION: Refugio Test Site

STATION NUMBER (COLS. 1-6): MLV #6 COMPOSITE CODE (COL. 7)*:

ANALYSIS	COLS. 8-9 ANALYSIS CODE	COLS. 10-15 MOL. FRACTION	GPM 14.696 PSIA @ 60° F	SP. GR. @ 60° F (AIR = 1)
CARBON DIOXIDE	01	0.0028		0.0043
NITROGEN	02	0.0028		0.0027
METANE	03	0.9469	16.049	0.5265
ETHANE	04	0.0344	0.074	0.0360
PROPANE	05	0.0097	0.266	0.0150
ISO-BUTANE	06	0.0020	0.065	0.0041
N-BUTANE	07	0.0009	0.028	0.0019
ISO-PENTANE	08	0.0005	0.018	0.0013
N-PENTANE	09			
HEXANES	10			
HEPTANES PLUS	11			
TOTAL		1.0000	17.300	0.5908

*COMPOSITE CODES:
1 - GREEN BRANCH LINE
2 - 16" VALLEY LINE
3 - DEAN (1+2)
4 - 26" VALLEY LINE
5 - SOUTH LOUISIANA LINE
6 - MAIN LINE TOTAL

FIELD DATA:
PRES. 690 PSI
TEMP. 78 °F
SP. GR. 0.597
H2O D. P. 7 °F @ 690 PSI
HYD. D. P. 48 °F @ 690 PSI
BTU -
SAMPLE Natural Gas
TAKEN BY O. L. Wilson
DATE 11-20-58
BOMB NO. M 6462

LAB. DATA:
ANALYSIS NO. 1568
DEV. TEST NO. 4094-95
ANALYSIS BY Charles E. Richardson
SP. GR. (BAL.) 0.597
SP. GR. (CALC.) 0.591
BTU (DRY) ** 1058
BTU (WET) ** 1038
BTU (DETERMINED)

REMARKS: **BTU/cu. ft. at 14.73 PSIA at 60° F
L.T.F.D. Analysis. Refugio Efficiency Tests.
Special Sample.

Fig. 3. Gas sample analysis.

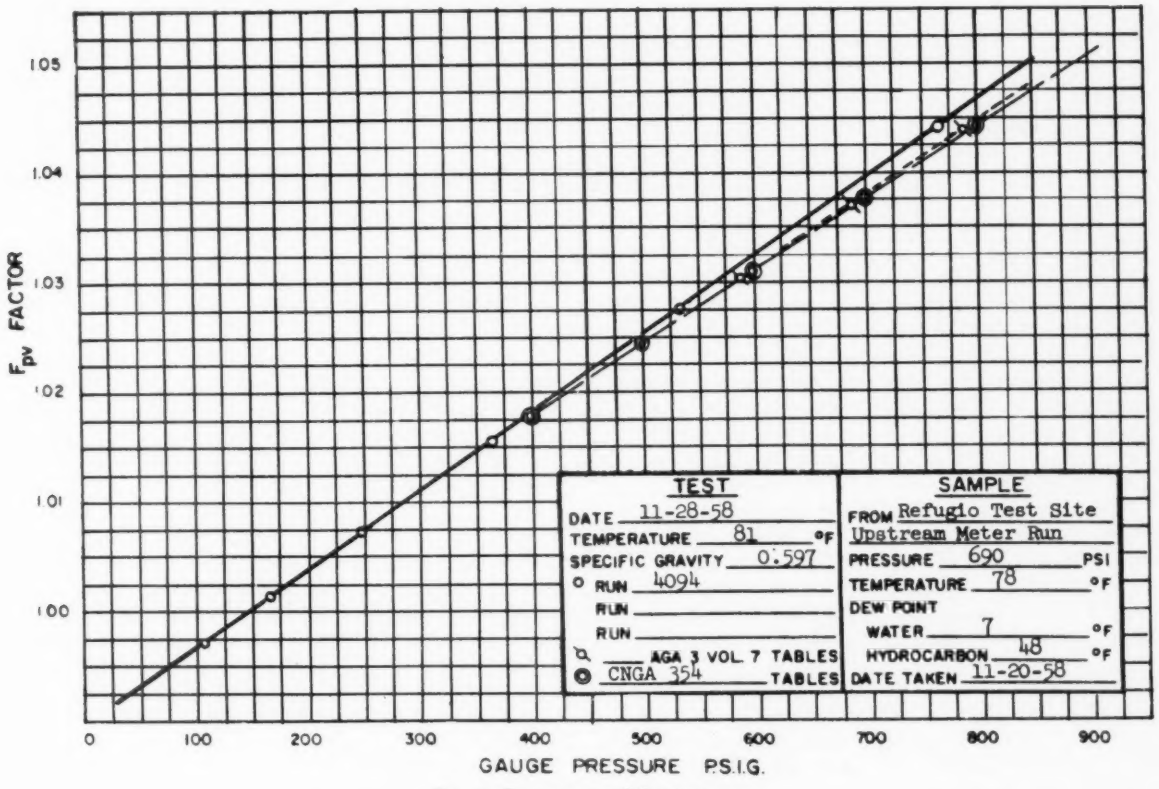


Fig. 4. Supercompressibility tests.

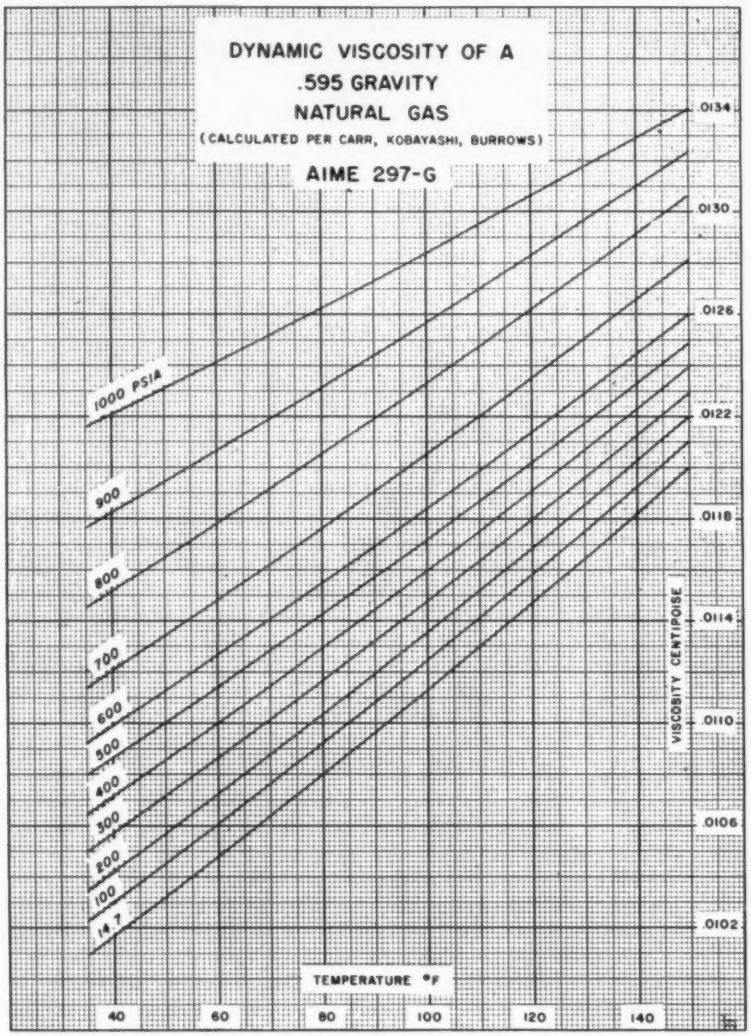


FIG. 5.

Normal precautions were taken during the tests; such as checking for gas leakage, levelness and stability, and shielding from wind and weather. The gauges were read to the nearest 0.05 psi.

Aneroid barometers were used to determine atmospheric pressure. These were checked against a certified column of mercury three times during the tests.

• Temperature

Fig. 2 shows how gas flowing temperatures were obtained. A piece of 5/16-in. steel tubing, sealed at the lower end, was pushed into the center of the gas stream through a packing gland. A thermocouple, which had previously been calibrated against a certified thermometer, was inserted in the tubing.

• Gas gravity

Specific gravity was determined with an ACME balance. There is some difference of opinion as to the absolute accuracy of this method. *Fig. 3* shows a typical gas sample analysis. It may be seen that calculated specific gravity differs from measured specific gravity by approximately 1 per cent. It is also true that expert operators of the balance will differ by as much as 0.5 per cent. Therefore, the Q_m as stated in *Tables 1, 2 and 3* have a possible error of as much as plus or minus 0.5 per cent. However, Q_m is inversely proportional to the square root of specific gravity. Thus the term $Q_m \sqrt{G}$ eliminates any error. Since equation (12) contains this term, the resistance coefficient, f, was not affected in any way by an error in specific gravity determination. This means that it is necessary to assume a constant specific gravity throughout the 20-minute test period. It would take a period of time for a certain particle passing the inlet of the test section to reach the orifice meter. This time lag varied from approximately 85 minutes at the low rate of flow to 28 minutes at the high rate of flow. For this period of time, it is believed that constant specific gravity is not an unreasonable assumption.

A changing specific gravity would of course mean

that Q_m and f would have to be calculated using different specific gravities.

• Supercompressibility

There are many names for this phenomenon. Basically it is a factor to adjust for the deviation from the ideal gas laws. Tests were made on each of the six random samples with a Burnett apparatus which was modified to maintain extremely close control over bath temperature. *Fig. 4* shows typical results. It indicated that either CNGA 354 or AGA 3 tables were sufficiently accurate for use in the range of temperatures and pressures stated in *Tables 1, 2 and 3*. Since Q_m is inversely proportional to the square root of Z, the Q_m as stated in *Tables 1, 2 and 3* may be in proportionate error. Since gas pipeline flowing temperature was very close to orifice meter gas temperature, any error in the calculation of f by using the tables was minimized, since equation (12) contains the term $Q_m{}^2Z$.

• Viscosity

The viscosity shown in *Tables 1, 2 and 3* was not measured. I believe the method of Carr, Kobayashi and Burrows[5] is sufficiently accurate for this determination. *Fig. 5* was developed by this method, and was used in determining gas viscosity.

• Gas quality

Fig. 3 contains information about one of the six random samples. Gas analysis was accomplished by low temperature fractional distillation (Pod Column). Components of the samples remained fairly constant, methane and ethane varying by only a few tenths of 1 per cent, and the heavier ends by a few hundredths of 1 per cent. Carbon dioxide was fairly constant at less than 0.3 per cent, thereby not appreciably affecting viscosity or the supercompressibility. Water and hydrocarbon dew points were obtained with the apparatus approved by the Bureau of Mines. A summary of these is shown in *Table 4*.

• Displacement measurement

Figs. 6 and 7 show the injection and detection apparatus. High pressure nitrogen was used to inject 3 to 5 lb of anhydrous ammonia into the gas stream. The injections were accomplished quickly by means of a ½-in. quick opening plug valve. The detection solution was dilute hydrochloric acid with a pH of 5.5, and Brom cresol purple as an indicator. Methyl

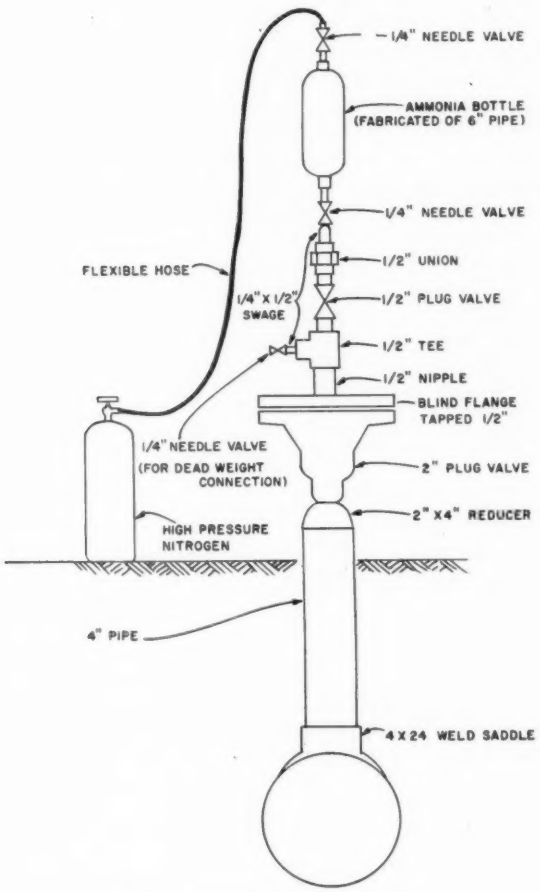


Fig. 6. Ammonia injection apparatus.

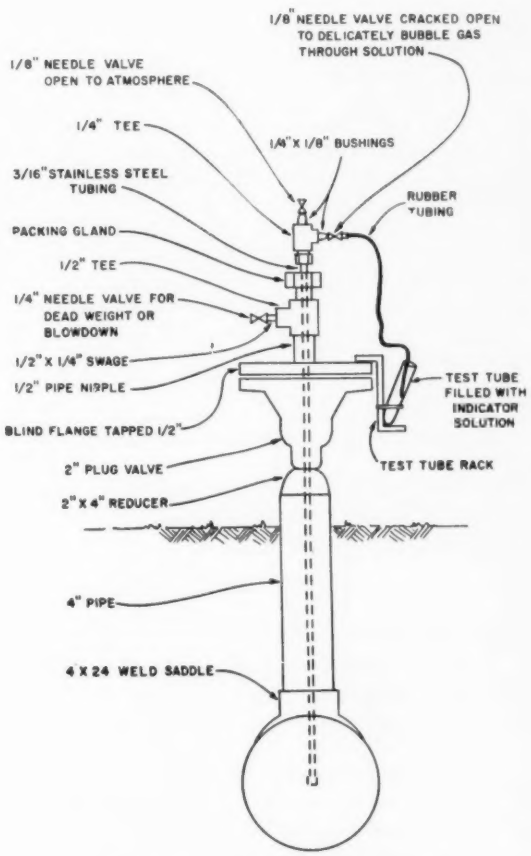

1/8" NEEDLE VALVE CRACKED OPEN TO DELICATELY BUBBLE GAS THROUGH SOLUTION
1/8" NEEDLE VALVE OPEN TO ATMOSPHERE
1/4" TEE
1/4" X 1/8" BUSHINGS
3/16" STAINLESS STEEL TUBING
RUBBER TUBING
PACKING GLAND
1/2" TEE
1/4" NEEDLE VALVE FOR DEAD WEIGHT OR BLOWDOWN
1/2" X 1/4" SWAGE
1/2" PIPE NIPPLE
BLIND FLANGE TAPPED 1/2"
TEST TUBE FILLED WITH INDICATOR SOLUTION
TEST TUBE RACK
2" PLUG VALVE
2" X 4" REDUCER
4" PIPE
4 X 24 WELD SADDLE

Fig. 7. Ammonia detection apparatus.

TABLE 4. INDICATIONS OF GAS QUALITY

Phase	Test No.	Water Content #/MM	Hydrocarbon D. P. °F	Pressure PSIA
1	1-A	3.25	51	710
	1-B	4.0	46	705
	1-C	3.85	50	650
	2-A	3.3	44	650
	2-B	4.2	55	640
	2-C	4.75	48	635
	3-A	2.9	44	715
2	1-A	3.9	41	715
	1-B	4.4	44	710
	1-C	4.0	40	700
	2-A	4.2	43	650
	2-B	4.5	42	635
	2-C	6.8	56	635
	2-CR	4.5	50	615
	3-A	3.2	48	705
3	1-A	3.6	38	705
	1-B	4.3	44	700
	1-C	4.4	41	695
	1-AR2	4.7	50	700
	2-A	3.9	41	660
	2-B	—	—	—
	2-C	3.7	39	645
	2-D	3.4	46	635
	3-A	3.9	44	710

alcohol was added to protect the solution from freezing.

Stop watches were used at the injection and detection points. Normal procedure was to start both watches by radio "count down." Then, exactly one minute later, the injection took place.

This method and apparatus was checked by timing a 20-ft travel distance several times. It was discovered that the error inherent in the apparatus is approximately one second. Other experiments showed that, over longer distances (10-20 miles), a lower pH indicated a longer travel time. The discrepancy in travel time is approximately 7-10 seconds per 1.0 difference in pH. During the tests, color change was abrupt and complete in all but one test run. Special care was taken to coordinate the testing, and "dispatch" the ammonia so it would not contaminate any of the gas samples, or interfere with specific gravity determination.

Discussion of Calculation Methods

NEGLECTING the change in kinetic energy, the equation for the resistance coefficient for a horizontal pipeline has been expressed[1] as:

$$f = \frac{13780\ T_B^2\ (P_1^2 - P_2^2)\ d_i^5}{Q^2 P_B^2 GTZL} \qquad (1)$$

where f = resistance coefficient, dimensionless
T_B = temperature base, °R
P_B = pressure base, psia
P_1 = initial pressure, psia
P_2 = final pressure, psia
d_i = internal pipe diameter, inches
Q = flow rate, scf/hour, measured at P_B and T_B
G = specific gravity of gas (air = 1.0)
T = average flowing temperature, °R
L = pipe length, feet
Z = average compressibility factor, dimensionless

Weymouth[2] derived essentially the same equation from Unwin[3], except for dimensions. The main difference is that Weymouth assumed ideal gas laws, hence his equation does not contain the Z term.

The resistance coefficient that is normally used outside the gas industry is calculated by the Darcy-Weisbach equation:

$$f_o = \frac{2gDh}{LV^2} \qquad (2)$$

where g = acceleration due to gravity ft/sec/sec
h = loss, feet of head
v = velocity, feet per second

Equation (1) may also be derived from equation (2), but there will be a difference in the constants. This difference resolves of the fact that the Unwin formula contains hydraulic radius as a term, and the Darcy Weisbach contains pipe diameter. Since the hydraulic radius of a pipe is equal to $d_i/4$, then:

$$f_o = 4f$$

Assumptions Made in the Calculations

No change in kinetic energy

The effect of the change in kinetic energy in the larger diameter pipes at economical flow rates is negligible. The maximum effect on the resistance coefficient was only 0.1 per cent.

Isothermal flow

The test site is located midway between two compressor stations that are approximately 90 miles apart. Being 45 miles from the discharge of the first station, the gas had a chance to approach ground temperature, and remain fairly constant. The maximum change between upstream and downstream gas temperatures was only 2.5 deg F for any flow rate.

Constant compressibility factor

The maximum variation in compressibility was approximately 1 per cent, occurring at the higher flow rates when there was a large pressure differential.

Correction for change in elevation

Letting

$$K = \frac{13780\ T_B^2 d_i^5}{Q^2 P_B^2 GTZ}$$

and restating equation (1)

$$f = \frac{K\ (P_1^2 - P_2^2)}{L} \qquad (3)$$

Then the differential equation, of which (3) is a solution, is:

$$pdp = \frac{fdL}{2K}$$

A uniform pressure gradient can be assumed without introducing any appreciable error, as long as the flow remains isothermal (or nearly) and the pressure differential (dp) remains a small percentage of P (say, 10 per cent or less). Then (4) may be solved as a difference equation and it can be stated:

$$L = dL \qquad (5)$$

$$P = \frac{P_1 + P_2}{2} \qquad (6)$$

Since equation (1) assumes a horizontal pipeline, dp is the pressure differential resulting from frictional resistance only. The pressure differential resulting from change in elevation must be considered.

Let dp_e = change in pressure due to change in elevation
dp_m = measured change in pressure, $(P_1 - P_2)$

Then

$$dp = dp_m - dp_e \text{ (the line is gradually sloping uphill)} \quad (7)$$

Substituting (5), (6), and (7) in (4):

$$\left(\frac{P_1 + P_2}{2}\right)(P_1 - P_2 - dp_e) = \frac{fL}{2K} \quad (8)$$

Letting H = the change in elevation (ft) and
W = specific weight lb/ft³

$$dp_e = \frac{WH}{144} = \frac{.0763\ GP\ 520}{144\ TZ\ 14.696}\ H = .01875\ \frac{GPH}{TZ} \quad (9)$$

Substituting (6) in (9)

$$dp_e = .00938\ GH\left(\frac{P_1 + P_2}{TZ}\right) \quad (10)$$

Substituting (10) in (8) and rearranging:

$$f = (P_1+P_2)\left(P_1 - P_2 - .00938\,GH\,\frac{P_1 + P_2}{TZ}\right)\frac{13780\,T_B^2 d_i^5}{Q^2 P_B^2 GTZL} \quad (11)$$

For use in the calculations of the data in this report:

T_B = 520 °R
d_i = 23.5 in.
P_B = 15.025 psia
L = 62,812.5 ft

$$Q = \frac{1{,}000{,}000\ Q_m}{24} \text{ (expressing } Q_m \text{ as MMscfd)}$$

H = 17.48 ft.

Substitution of the above constants in (11) results in the final equation:

$$f = \frac{1.0847\,(P_1 + P_2)\left[P_1 - P_2 - .16396G\left(\frac{P_1 + P_2}{TZ}\right)\right]}{Q_m^2 GTZ} \quad (12)$$

Correction for position of deadweight gauges

The deadweight gauges were read on top of the ground, setting on a tripod. Both upstream and downstream pressures were taken at a point approximately 8 ft above the pipe. Hence, the weight of a column of gas 1 sq in. in cross-section and 8 ft high, plus the atmospheric pressure, was added to the deadweighted pressure.

$$P_{1,2} = P_{D\ W} + P_{ATM} + .150\,\frac{GP_{1,2}}{T_{1,2}\,Z_{1,2}}$$

Reynolds Number:

$$N_R = \frac{WDV}{M}$$

where W = specific weight lbs/ft³
D = pipe diameter, ft
V = velocity, ft/sec
M = dynamic viscosity, lb/sec ft

$$W = 2.6998\,\frac{GP}{TZ}$$

$$V = \frac{4}{\pi}\,\frac{1{,}000{,}000}{86{,}400}\,\frac{Q_m TZP_B \times 12^2}{d_i^2 PT_B}$$

$$V = 2122.1\,\frac{Q_m TZP_B}{d^2 PT_B}$$

Substituting:

$$N_R = \frac{2.6998\,\frac{GP}{TZ} \times \frac{2122.1\,Q_m TZP_B}{d_i^2 PT_B}\,\frac{d_i}{12}}{M}$$

and:

$$N_R = 477.44\,\frac{GQ_m P_B}{d_i T_B M} \quad (13)$$

For use in this report:

P_B = 15.025 psia
d_i = 23.5 in.
T_B = 520 °R

$$N_R = .587\,\frac{GQ_m}{M} \quad (14)$$

Ammonia Displacement Calculations

THE theory of ammonia displacement is simple. By obtaining pressures, temperatures, gravity and compressibility factors at the upstream and downstream ends of a section of known pipe volume, the standard cubic feet of "stored" gas can be computed by Boyles and Charles law. Letting V_s = standard cubic feet per unit of length at any point and A = cross-sectional area of pipe:

$$V_s = \frac{P\,T_B}{TZ\,P_B}\,A \quad (15)$$

Then, by "marking" the upstream end of this calculated quantity, and observing the time required for the mark to travel to the downstream point, a flow rate is established.

It has been found, from past experience, that displacement tests cannot be conducted over a great distance with a reasonable degree of accuracy. And when tests are conducted where there is a large variation in temperature, the average V_s is subject to considerable error when calculated by means of $\frac{P_{avg}}{T_{avg}\,Z_{avg}}$.

However, if we assume a uniform variation of specific volume over these short distances, the chances for considerable error are minimized. Then:

$$V_{s_{avg}} = \frac{V_{s_1} + V_{s_2}}{2} = \frac{T_B\,A}{2\,P_B}\left(\frac{P_1}{T_1 Z_1} + \frac{P_2}{T_2 Z_2}\right) \quad (16)$$

If

T = travel time, minutes

$$V_{s_{avg}} = \frac{Q_m \times 10^6\,T}{1440\,L}$$

Then:

$$\frac{Q_m \times 10^6\,T}{1440\,L} = \frac{T_B \times d_i^2}{2P_B 4 \times 144}\left(\frac{P_1}{T_1 Z_1} + \frac{P_2}{T_2 Z_2}\right)$$

And:

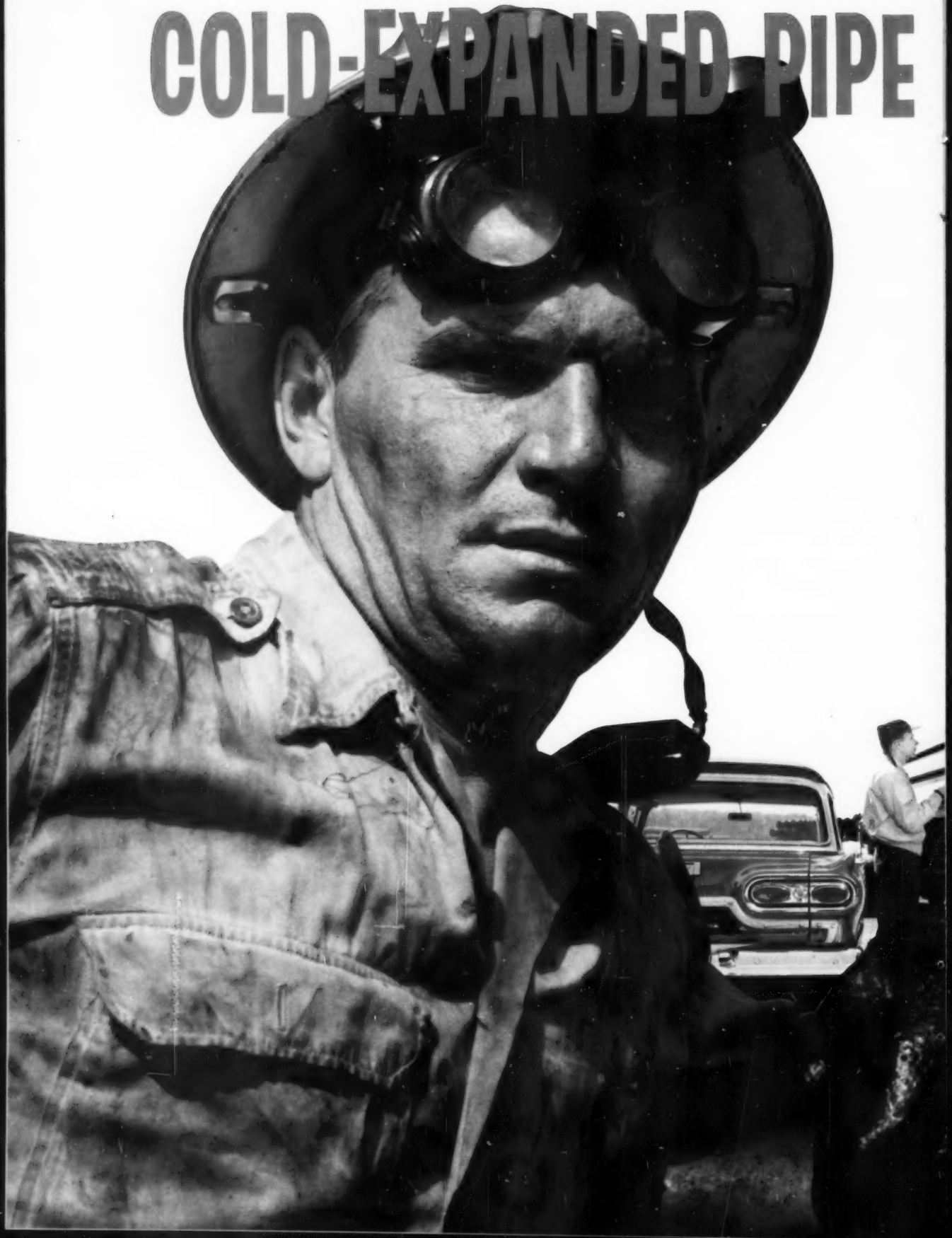
$$Q_m = \frac{3.927\,T_B\,d_i^2\,L}{T\,P_B \times 10^6}\left(\frac{P_1}{T_1 Z_1} + \frac{P_2}{T_2 Z_2}\right) \quad (17)$$

For use in this report:

L = 62812.5 ft
d_i = 23.5 in.
T_B = 520 °R
P_B = 15.025 psia

$$Q_m = \frac{4714.5}{T}\left(\frac{P_1}{T_1 Z_1} + \frac{P_2}{T_2 Z_2}\right) \quad (18)$$

COLD-EXPANDED PIPE



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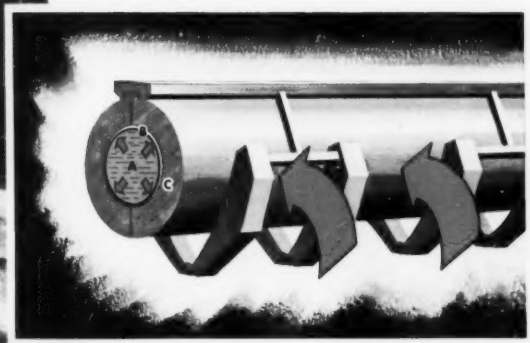
Remember, Youngstown Electric Weld Line Pipe is hydrostatically expanded to uniform roundness. In this operation (see below), internal water pressure (A) forces the pipe (B) outward against the solid walls of a mantle (C). Cold-expansion provides a lighter, stronger pipe for carrying higher line pressures. As a result of this process, cold-expanded line pipe has increased field weldability.

For particulars about Youngstown Electric Weld Line Pipe, contact our sales and field engineering offices strategically located throughout the oil and gas-producing country. The Youngstown Sheet & Tube Company, Youngstown 1, Ohio.



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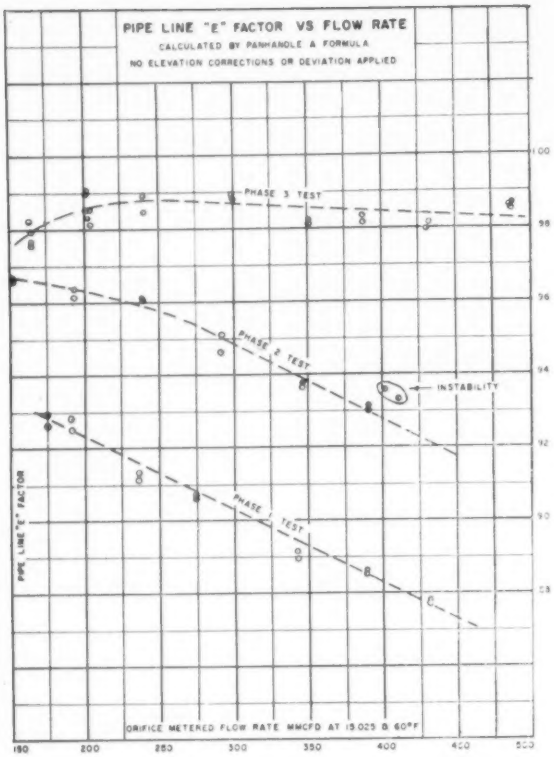

FIG. 8.

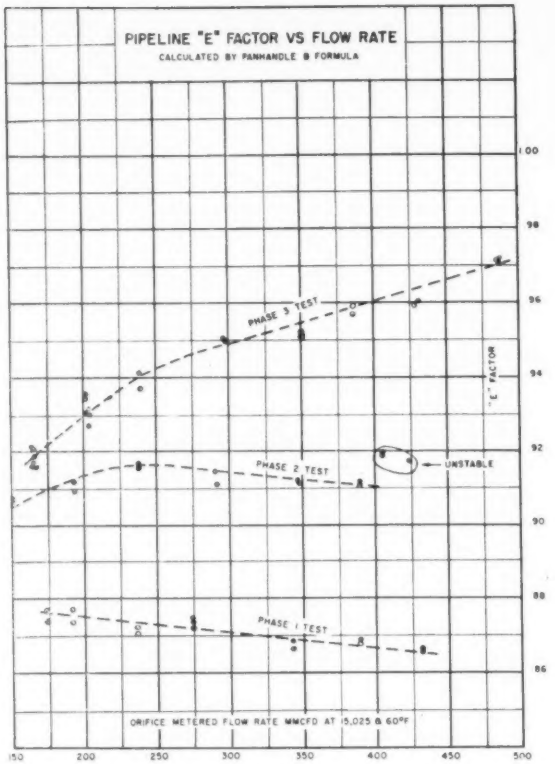

FIG. 9.

Discussion

• General

Experiments have shown that the resistance coefficient is a function of Reynolds Number when the flow is laminar, or streamline. As the flow laminations are broken, a family of curves develop. These curves of the resistance coefficient are a function of Reynolds Number and the relative roughness of the pipe.

The relative roughness is a dimensionless ratio of interior surface roughness to pipe radius. The lower limit of the resistance coefficient is termed the "Smooth Pipe Law."

As the degree of turbulence increases, the resistance coefficient departs from the smooth pipe law and becomes a constant. It is then a function of relative roughness only. The family of constants is termed the "rough pipe law."

Experiments by Nikuradse[6] laid much of the groundwork for present day methods of analysis. However, Nikuradse created an artificial roughness of the interior by using uniformly screened grains of sand, and experimented with rather small pipe diameters and short distances. Colebrook[7] attempted to mathematically describe the transition from the smooth pipe law to the rough pipe law. The experiments of the Bureau of Mines[1] have shown that the transition from "smooth" to "rough" is much sharper than the Colebrook equation indicates. But again, small pipe diameters and short distances were necessary for the Bureau of Mines tests. The question to be resolved by the Refugio tests therefore, was: Does the condition of the internal pipe surface have much of an effect upon deliverability in a large diameter pipe in commercial use?

This question is answered by an examination of *Fig. 11*. The total increase in the transmission factor, which is directly proportional to deliverability, varied from approximately 5 per cent at a Reynolds Number of 7,000,000 to about 10 per cent at a Reynolds Number of 18,000,000. As calculated by Tennessee Gas Pipeline Co. engineers using Nikuradse's[6] rough pipe law, the roughness of Phase 1 was 912 microinches and Phase 2 was calculated at 520 microinches. Phase 3 roughness could not be calculated since the transmission factor did not become constant, but the writer estimates (by continuation of Phase 3 curve) something less than 180 microinches.

Northern Natural Gas Co. engineers obtained average roughness of 952 microinches for Phase 1, 573 microinches for Phase 2, and 413 microinches for Phase 3. Northern's computations are averages of all flow values for each phase.

Actual measurement of the roughness would have required many separated measurements in order to assure a representative value. This was impractical because of the excavation and cutting required. No distinct line can be drawn to break down the increases which are directly attributable to the cleaning or to the coating, since a wire brush cleaning operation was

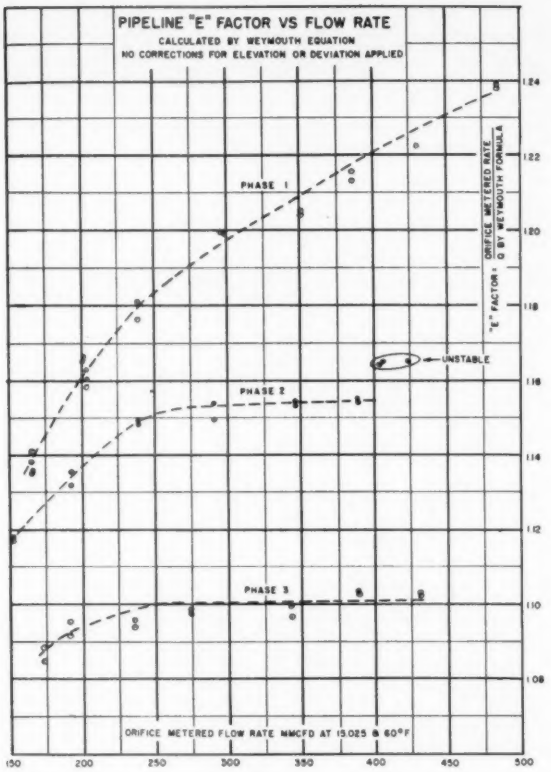

FIG. 10.

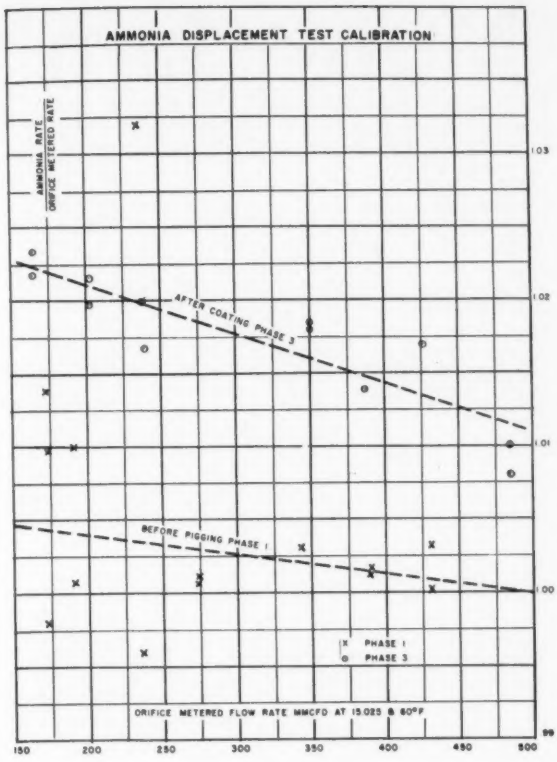

FIG. 12.

performed in both phases. However, the glass-like surface of some of the epoxies is well known, and it is a matter of conjecture as to how many wire brush pigs are necessary to attain this smoothness.

• Smooth pipe law

Close examination of *Fig. 11* reveals that the tests indicate a smooth pipe law evolving a transmission factor about 4 per cent less than that of Von Karman. There are several reasons for this apparent discrepancy. In order of importance, they are:

1. The characteristics of commercial use. The work of the Bureau of Mines was a valuable addition to the knowledge of flow characteristics. It showed that small amounts of liquid or solid material in the pipeline had considerable effect upon deliverability. The bureau filtered all of the gas in verifying Von Karman's equation for smooth pipe.

Although the gas used in testing the 24-in. line was dehydrated, and a large portion processed by gasoline plants, it is believed there still was sufficient foreign material present to appreciably affect the transmission factor. The writer believes that any unfiltered stream will produce similar results. Foreign material present in natural gas lines can include powdered desiccants, compressor lubricating oil, scrubber oils, valve greases, and condensate, to name a few.

2. Bends. Another factor contributing to the discrepancy was the 79 wrinkle bends in the test section.

No. of Bends	Wrinkles	Approximate Degree of Bend
2	1	2
54	2	4
10	3	6
5	4	8
3	5	10
2	6	12
1	7	14
1	9	18
1	13	26
79		

The bends would add some resistance to flow, leading to an error. One way of correcting this error is to use "equivalent" length, rather than actual length. To obtain agreement between the Phase 3 tests and the Von Karman smooth pipe law would call for allowing 63 ft of additional pipe per bend, or 23 ft additional per wrinkle. This may be far too much to allow, since the wrinkle is a depression of the interior, rather than an intrusion into the interior.

3. Different roughness. The total length of the test section (between pressure measurement stations) was 62,812.5 ft. Of this, 147.7 ft was not cleaned in Phase 2, nor coated in Phase 3. Operations were started 65.9 ft downstream of the upstream tap, and completed 81.8 ft upstream of the downstream tap. Thus, the test section presented two different surfaces to the stream. Since this is only .23 per cent of the total length, it was not considered important.

4. Possible error in viscosity. Viscosity was calcu-

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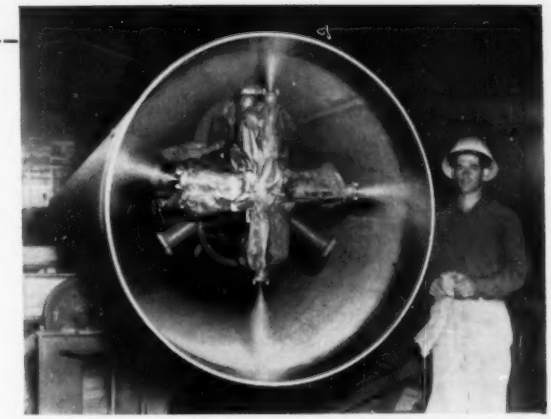
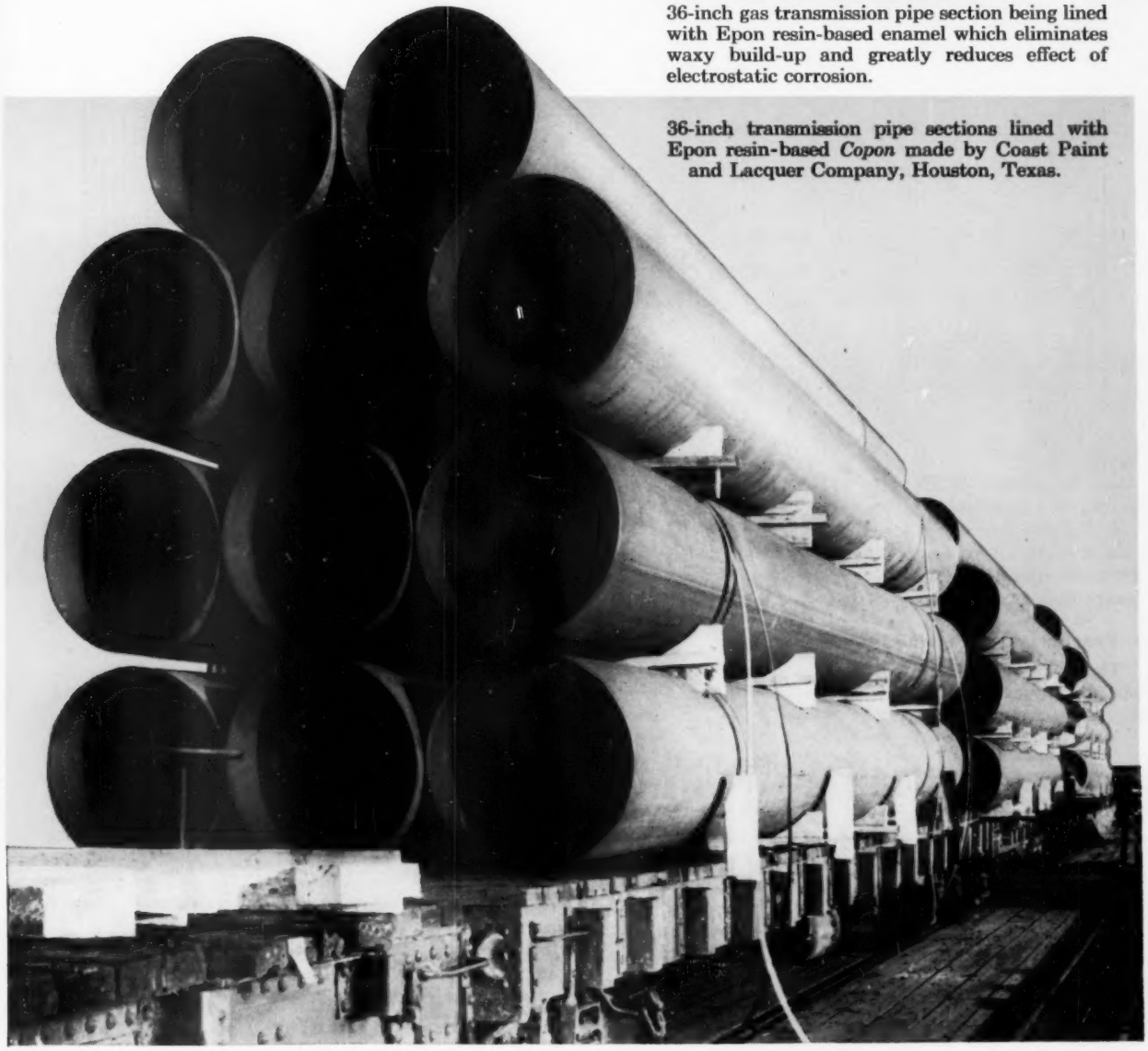


36-inch gas transmission pipe section being lined with Epon resin-based enamel which eliminates waxy build-up and greatly reduces effect of electrostatic corrosion.



36-inch transmission pipe sections lined with Epon resin-based *Copon* made by Coast Paint and Lacquer Company, Houston, Texas.

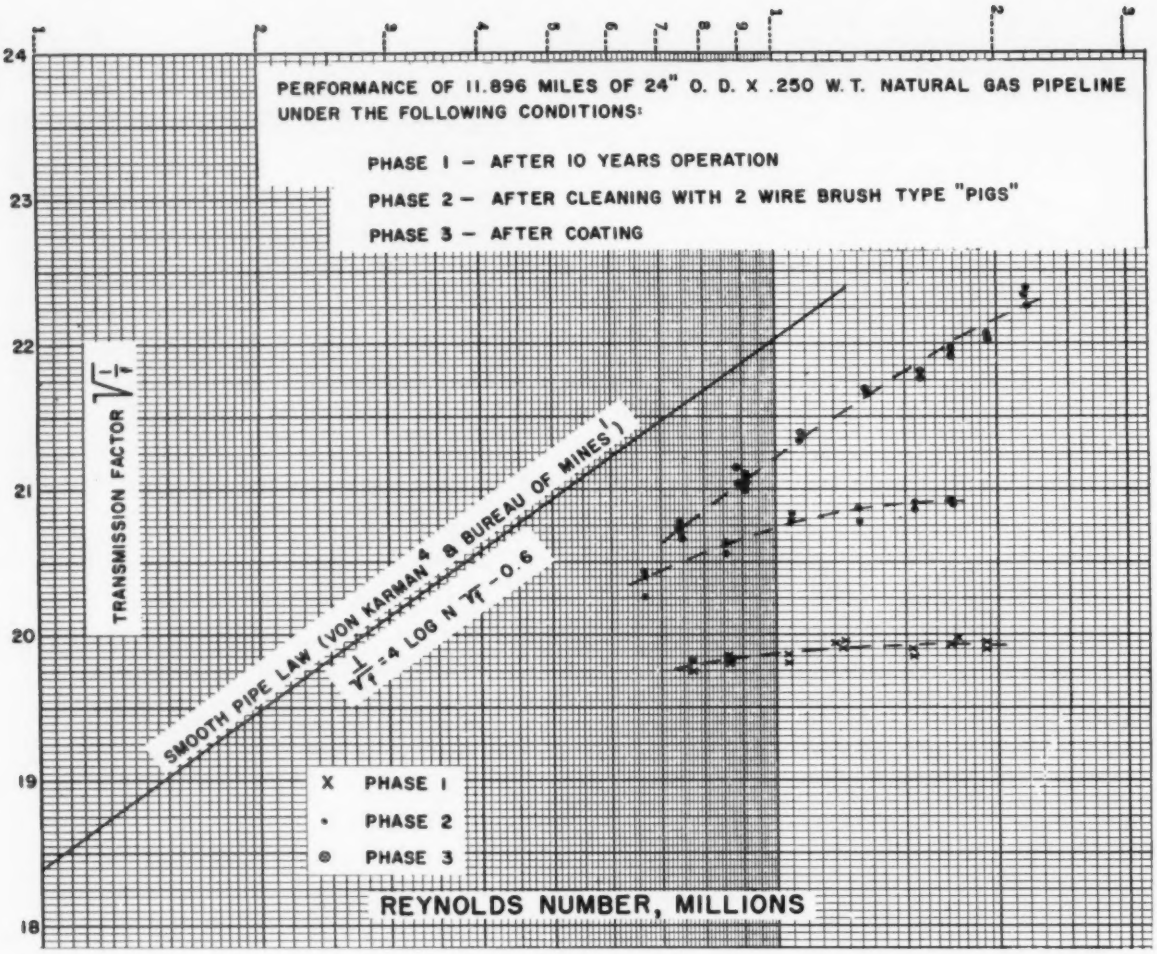

PERFORMANCE OF 11.896 MILES OF 24" O. D. X .250 W. T. NATURAL GAS PIPELINE UNDER THE FOLLOWING CONDITIONS:
PHASE 1 – AFTER 10 YEARS OPERATION
PHASE 2 – AFTER CLEANING WITH 2 WIRE BRUSH TYPE "PIGS"
PHASE 3 – AFTER COATING
TRANSMISSION FACTOR $\sqrt{\frac{1}{f}}$
SMOOTH PIPE LAW (VON KARMAN & BUREAU OF MINES)
$\frac{1}{\sqrt{f}} = 4 \log N_R \sqrt{f} - 0.6$
X PHASE 1
• PHASE 2
⊙ PHASE 3
REYNOLDS NUMBER, MILLIONS
24
23
22
21
20
19
18

FIG. 11.

lated, not measured. However a fairly large error is needed to appreciably shift plots to right or left.

5. Reduction in diameter. A calculation of the gallons of coating used shows an average 6 mil thickness. This reduction of diameter theoretically will affect the transmission factor by slightly more than 0.1 per cent.

• Practical smooth pipe law

The smooth pipe law of Von Karman and the Bureau of Mines states:

$$\frac{1}{\sqrt{f}} = 4 \log N_R \sqrt{f - 0.6} \qquad (19)$$

For practical application, the effect of bends and foreign materials may be taken into account by writing a "practical" smooth pipe law. For extremely smooth pipe in commercial use, the resistance coefficient of equation (19) can be assumed from the results to be approximately 92 per cent of the actual resistance coefficient. Thus, a "practical" smooth pipe law:

$$\frac{1}{\sqrt{.92f}} = 4 \log N_R \sqrt{.92f} - 0.6 \qquad (20)$$

which reduces to:

$$\frac{1}{\sqrt{f}} = 3.84 \log N_R \sqrt{f} - 0.5 \qquad (21)$$

The author suggests that this equation could be used for estimating purposes with more accuracy than equation (19).

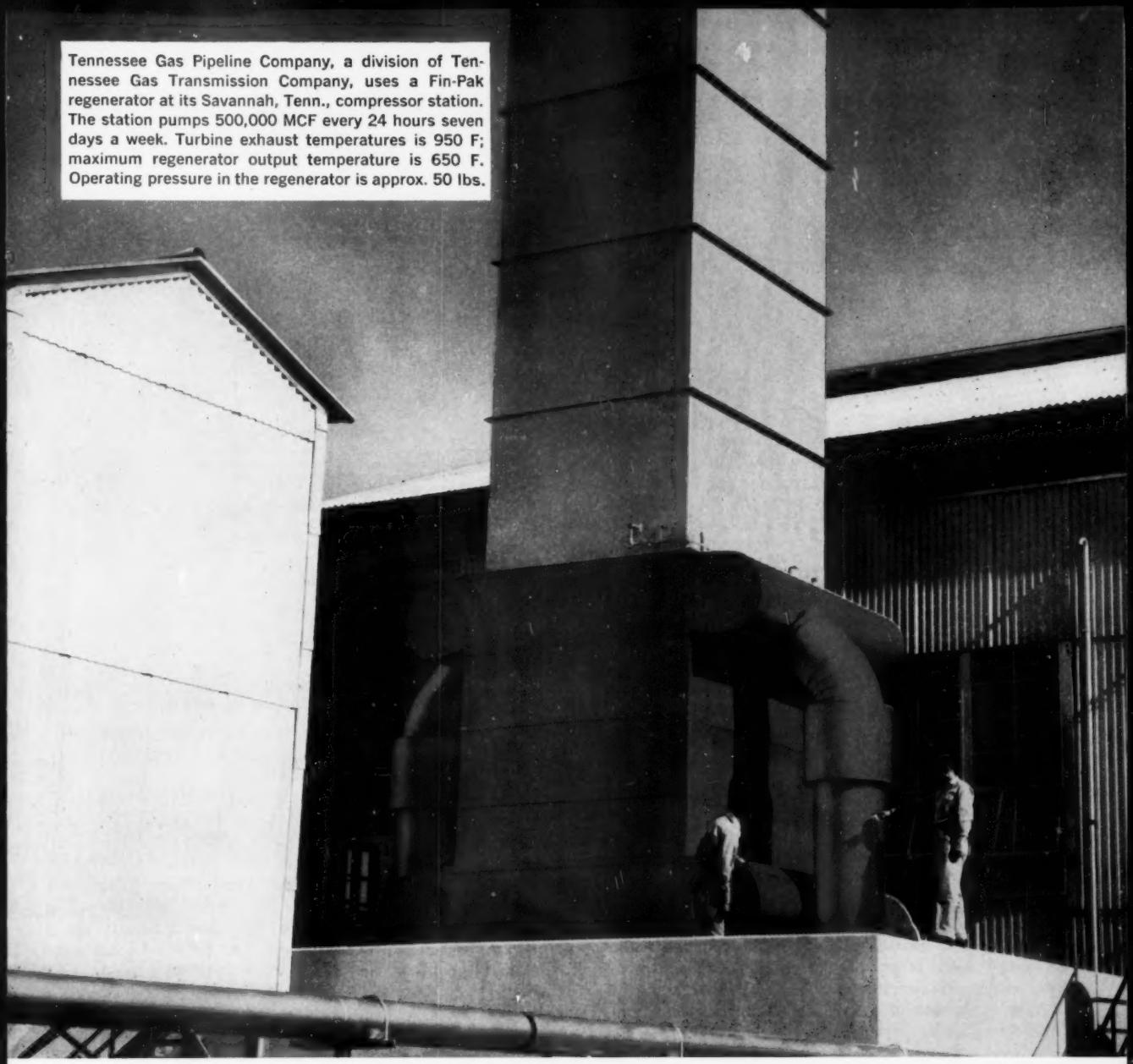
• Flow formulas

It is beyond the scope of this article to discuss the different flow equations. However, as a basis of comparison, *Figs. 8, 9 and 10* are included in this report to show the effect of the change in roughness and the change in throughput upon the E factor of three of the equations in common usage.

• Ammonia tests

The ammonia injection tests were conducted with equipment and techniques developed by Tennessee Gas engineers in 1953, based upon the initial development of the method by Panhandle Eastern Pipe Line Co.

Fig. 12 indicates that the rate of flow calculated by ammonia displacement increases with decrease in



Tennessee Gas Pipeline Company, a division of Tennessee Gas Transmission Company, uses a Fin-Pak regenerator at its Savannah, Tenn., compressor station. The station pumps 500,000 MCF every 24 hours seven days a week. Turbine exhaust temperatures is 950 F; maximum regenerator output temperature is 650 F. Operating pressure in the regenerator is approx. 50 lbs.

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roughness. Or stated in another way, the smoother the pipe, the less the travel time of the ammonia. This indicates that the calibration is dependent upon the degree of turbulence. Gaseous ammonia has approximately the same specific gravity as the gas, and will therefore mix readily and completely at the injection point. In traveling over a distance, however, the dispersion of the ammonia is dependent upon distance and the velocity profile. The travel time is some function of the maximum velocity.

The smoother the pipe, the less turbulence, and the velocity profile is more nearly parabolic. As flow or roughness increases, the profile flattens and the maximum velocity approaches the average velocity. From the ammonia calibration graph, therefore, we can conclude that the degree of turbulence for the high rate of flow in Phase 3 is slightly less than that for the low rate in Phase 1. It indicates that Phase 3 is about to begin an abrupt departure from the trend shown in *Fig. 11*. This was the basis used in estimating the 180 microinch figure previously discussed.

From the results, it is reasonable to assume that injections of radio-active materials are subject to the same calibration.

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ACKNOWLEDGMENT

This project was made possible by the joint efforts of many of the personnel of the contributing organizations. Special credit is due to the pipeline, compressor and measurement personnel of Districts 1 and 9 of the Tennessee Gas Pipeline system.

Supplement to Report of Pipeline Flow Tests

APPROXIMATELY 100 ft of pipe was removed from the test section on April 6, 1959. There was a two wrinkle sag bend in the portion removed.

The interior of the pipe that was removed was examined and found to be completely coated. A depth of 2 in. of dry coating lay in the lowest part of the sag, tapering off to a depth of about $\frac{1}{8}$ in. where the pipe was straight and more nearly horizontal. The extra thickness of coating was observed over approximately 50 ft of pipe length (see *Fig. 1-A*).

During the cleaning operations of Phase 2 and the cleaning and coating operations of Phase 3, every pig or plug was temporarily stopped at or near the area in which the pipe was removed. It is possible that this excess coating material was deposited while the plugs were stopped. The equivalent length of non-circular cross-section may be obtained in terms of circular cross-section by the following, in consistent dimensional units:

$$Le = La \frac{A_c^2 H_c}{A^2 H}$$

Le = Equivalent Length
La = Actual Length
A = Cross-Sectional Area
H = Hydraulic radius
(Subscript c refers to circular cross-section)

A 2-in. deposit of material reduces the cross-sectional area by about 4 per cent and adds approximately 12 per cent to the length.

Thus, if it is assumed that the maximum depth is effective over half the distance of the tapered depth, the deposit of coating adds only 3 ft to the total distance.

A phenomenon was noted in the examination of the pipe interior. The walls of the pipe were "striped" parallel to the flow, with very fine lines of dust deposit. In the section of pipe where there was no additional thickness of coating, these stria were observed around the full circumference. They could easily be wiped clean, exposing a slick surface of coating underneath. ■

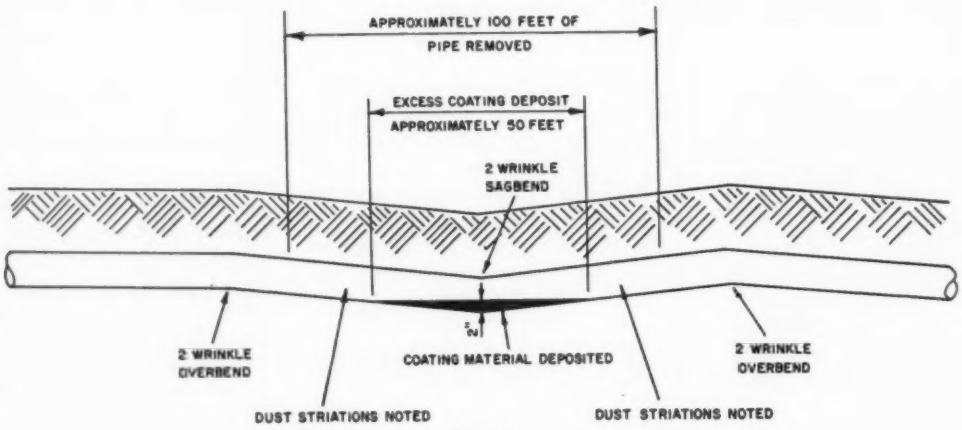

Fig. 1-A.

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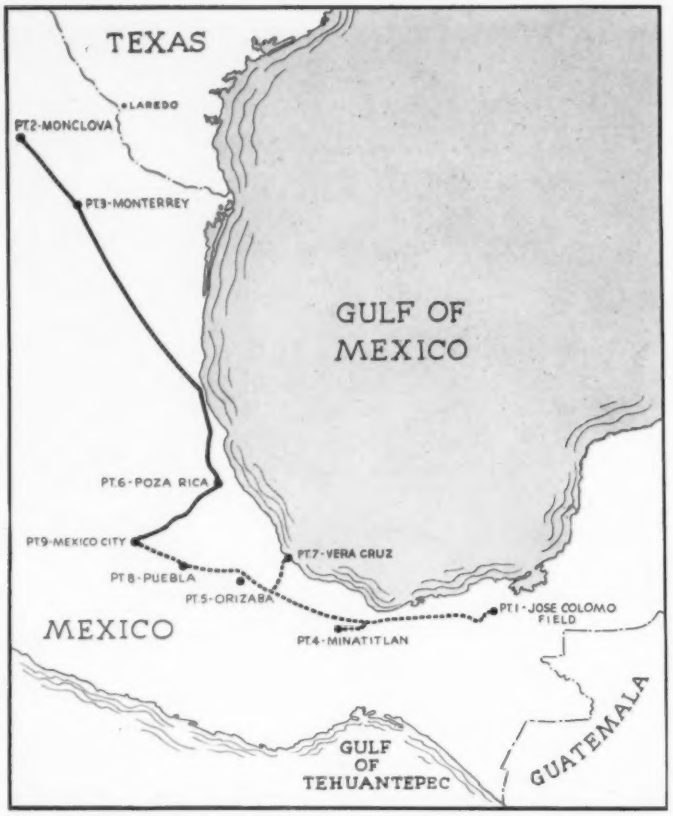


GAS exclusive

Building an extra high pressure line in Mexico

By F. VINTON LONG
Texas Eastern Transmission Corp., Shreveport

ON Feb. 17, I presented a paper to a group of engineers whose activities might well be of interest to the gas industry of the United States.

This group was largely members of the Asociacion de Ingenieros Petroleros de Mexico. Quite a few of the members are part of the PEMEX organization (Petroleos Mexicanos), including the association president, Alfonso Barnetche, who is manager of exploitation.

The paper was entitled "Tele-control of Pipelines" and the association meeting was held at a dinner at the Reforma Hotel in Mexico City and it was certainly first class. After presentation, questions were invited from the audience and some of them were indeed penetrating and indicated that the questioners were extremely well informed and had a vivid interest in oil and gas activities.

This visit to Mexico brought out strongly that we have extremely good neighbors in that country, and that PEMEX is an up and coming organization with excellent engineers.

Of their several activities, this article will concentrate on two:

a. The 24-in. gas line from the Jose Colomo field to Mexico City.

b. What might well be the world's longest extra high pressure gas line.

We will start off both with a rundown on the PEMEX organization, which is shown in *Fig. 1*. As this article deals with only gas pipelines, organization details are limited to those directly concerned with gas transmission.

Included in the exploitation division are engineers Jose Mendoza, who heads up communications for PEMEX, and Sotero Prieto, who does economic studies. Both of these men have a great deal of knowledge of what is going on in the gas industry and are extremely progressive, as is also PEMEX's management.

Mr. Prieto's calculations were used by his management to help decide on the calculated gamble of the high pressure gas line to be later described.

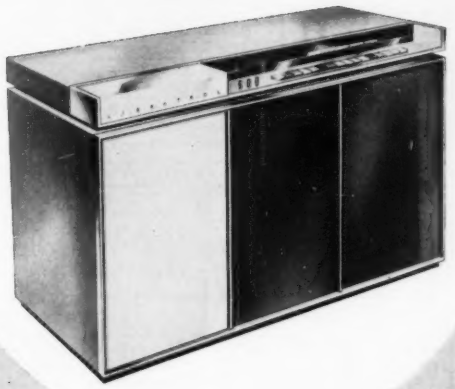
The general director is no novice to industry. He was formerly director of the Altos Hornos steel mill and it appears that he will diligently push the progress of PEMEX activities.

• Colomo Field—Mexico City gas line

The new gas line to supply Mexico City will originate at Jose Colomo field at Ciudad Pemex, state of Tabasco. (This is shown as Point 1 on the map and a little west of Villa Hermosa.)

The section between Colomo and Minatitlan is now underway, using plate from the Altos Hornos steel mill at Monclova (Point 2 on map).

There is a neat arrangement whereby after the plate is produced at Altos Hornos, it proceeds to Monterrey (3 on map) for rolling and then directly to the line. This eases the transportation problem considerably.



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SPEED: 66 samples per second.
NUMBER: 8, expandable to 512 with additional optional plug-in components.
SEQUENCE: By computer command; changeable by program.
VOLTAGE RANGE: 0-1 and 0-10 (or more) volts d.c.
MANUAL: Flexowriter and punched paper tape.
DIGITAL CLOCK: Internal, pure binary, real time to provide time of day for logging.

OUTPUTS
Flexowriter and punched paper tape; and computer logic producing 10-bit addressable word to actuate relays for control signals.
SPEED AND NUMBER: 66 outputs per second; time-sharing permits unlimited number.
SEQUENCE: By computer command; changeable by program.
TIME READOUT: From digital clock.
TYPICAL OPTIONAL CONTROL FUNCTIONS AVAILABLE: Alarms, voltage level, bridge balance, relay closure, setpoint, reset rate, proportional band, variable time delay, recorder, plotter.

GENERAL SPECIFICATIONS
COMPUTER TYPE: General-purpose digital.
NUMBER BASE: Binary.
MODE OF OPERATION: Serial.
INSTRUCTION TYPE: Single address.
NUMBER OF DIFFERENT INSTRUCTIONS: 16
MEMORY TYPE: Magnetic drum.
MEMORY CAPACITY: 4096 words.
WORD LENGTH: 30 bits plus sign.
CLOCK FREQUENCY: 136 KC
ADD TIME (Excluding Access): 0.25 milliseconds.
MULTIPLY TIME (Excluding Access): 15 milliseconds.
WEIGHT: 1000 lbs. nominal.
SIZE: 30" x 42" x 60".
POWER REQUIREMENTS: 117 volts (±10%) 17 amperes 60 cycles.

OPTIONAL EQUIPMENT
PHOTOELECTRIC READER: High-speed punched paper tape input for buffer storage.
MAGNETIC TAPE: Storage for additional input, output, and computing information.
MAGNETIC-CORE MEMORY: For quick access to stored data.
PUNCHED CARD INPUT.
LINE PRINTER: High speed data-logger printing 14 digits at a time.
TYPEWRITER SELECTOR: For multistation printout.
RELAY SENSING EQUIPMENT: For changing computer program in accordance with plant or product requirements.
GRAPHIC PANELS: For visual display of information.
CONSTANTS PANEL: Manual digital data insertion or readout for operation by nontechnical personnel.

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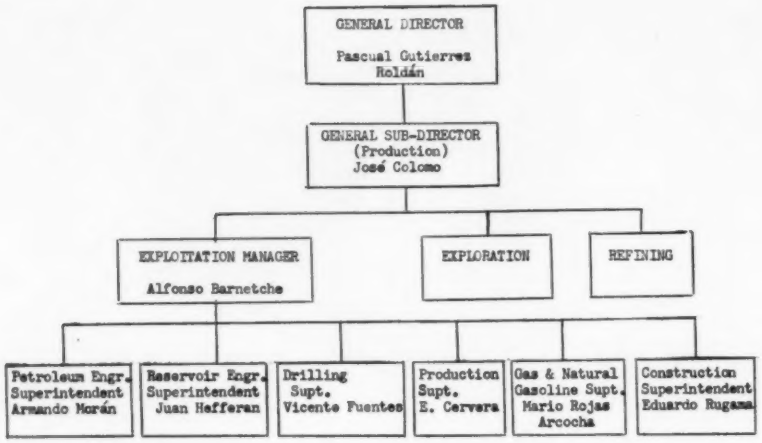

Fig. 1. Organization chart of PEMEX.

It should be brought out that with any PEMEX transmission line design, it is possible that optimum operational technical considerations as to the size of the line and other items must often be overweighed by the availability of pipe from Mexican plants. The ability to use pipe produced in Mexico and bought with local currency will often spell the difference between success and failure to finance a desired project.

As a matter of fact, a considerable factor in the start of construction of the first portion of the 24-in. Colomo Field-to-Mexico City line was the cooperation in working out of financing arrangements between Pascual Gutierrez Roldan (at that time director of the steel mill) and A. J. Bermudez (at that time director of PEMEX).

Compressors for this line will be under consideration in 1959, for installation in 1960. Target date for completion of the entire line is 1960.

This line will operate at first up to about 160 MMcf per day with no compressors as there will be 1800-lb pressure off the absorption plant at Colomo field.

The first compressor station is scheduled for Minatitlan (4 on map), and the second at Orizaba (5 on map) where there is a beautiful snow capped volcano called Citlatepetl in Aztec.

One of the prime reasons for this new line is to tap a gas source from Colomo field, as the existing field at Poza Rica (6 on map) is now at its top gas delivery volume of 32 million ft per day. The rest of production must of necessity be used repressuring the field. This means a cut-off of further outside sales, and bottlenecks the sale to Mexico City through the existing line to the present maximum of about 32 million. Poza Rica is on the Gulf Coast, 180 miles northeast of Mexico City.

Mexico City can use at least 100 million ft immediately for general industry such as glass and chemical plants, refineries, steel mills, and refractories (brick). So they will welcome the additional gas soon to be available. Other delivery points of the new line are:

Minatitlan: Where the three major users will be the refinery, Pan American Sulphur, and Gulf Sulphur. They will use about 20 million ft.

Coatzacoalcos: Where about 5 million ft will be used by a 200-ton per day ammonia plant now being engineered by Fluor Corp.

Vera Cruz Lateral: (7 on map). About 25 million ft. The principal users will include a mobile electric plant at Los Robles operated by the Federal Electric Commission. This will consist of a Clark Bros. gas-fired turbine of 6200 kilowatts which is now in operation. At present the fuel for this plant is obtained from San Pablo (1.5 million) and Angostura (1.0 million).

Other consumers will be a power plant at Dos Bocas operated by "CFE" (Comision Federal de Electricad), and the TAMSA (Tubos de Acero Mexicanos) pipe mill.

Cordoba: For breweries.

Puebla: (8 on map). Cement and tile plants.

Mexico City: (9 on map). A variety of sales, including the Atzcaptzalco refinery (northeast of the city) and other plants. A need for 100 million, which will be about all they can obtain from this line until compressors are installed.

You will note that the heavy drawoff from the line prior to reaching Mexico City will permit barely 100 million under construction of Phase One. This will be improved when the line is beefed up to 400 million ft when all phases are completed.

Right now reinjection surface pressures at the Colomo field are from 3500 to 4000 lb. As the new line becomes loaded they will cut down on reinjection volume which is now 100 to 150 million ft daily.

• Extremely high pressure line

Background: PEMEX discovered a new field at San Andres which is about 40 kilometers (25 miles) south east of the older Poza Rica field (6 on map). The production zone is between 10,000 to 12,000 ft with required injection pressures of 3800 to 4200 lb at surface.

It was quickly discovered that bottom hole pressure was declining very rapidly ("Falling like hell," as one engineer put it!) and at this time they also found that they could omit repressuring at Poza Rica itself for approximately 18 to 24 months without detrimental effects on the Poza Rica formation.

In other words, the decline of the San Andres field would have reduced production from 75,000 to 32,000

bbl daily, or cost them about 43,000 bbl daily, if repressuring was not used.

• What was done

A study was made for boosting the gas at San Andres itself versus using a 37 kilometer line to transport repressuring gas from Poza Rica and injecting at a pressure of 4000 psi maximum. This would require an initial pressure of about 4600 lb at Poza Rica.

At this time, during the study of the problem, it was brought out that it would be possible to obtain the required 6-in. high pressure pipe from the new steel mill at Vera Cruz (TAMSA) and buy it in pesos, and thereby spend the least amount of imported dollars.

This problem was quite a worry for PEMEX. But after a lot of study their engineers decided to take a calculated risk and install what may be the world's longest high pressure line, with the full knowledge of the troubles that they would encounter based on the line already in operation at the Jose Colomo field at Tabasco.

The PEMEX engineers did an excellent job in this design and in their decision to solve the problem as they did.

• Here are details

The pipe is seamless 0.562-in. thickness produced by TASMA at Vera Cruz and will be stress relieved at the welds. Ten passes would be an average weld condition on this line with the average lengths of tubing from 18 to 21 ft.

They plan to hydrostatically test this line with water to possibly 7000 psi, but will not carry it to yield. They have not as yet tested to yield but are coming very close to it, and discussions with their engineers bring out the fact that they are seriously studying things such as the advantages of welding during the cool nights or hot days and the four-way stresses on any weld.

Piping at the compressor station is $\frac{7}{8}$-in. wall.

The compressors, which are at the intake side of the line at Poza Rica, are three Clark HRA-8, 880-hp gas engine-powered, with one being a spare.

They take suction at 2500 psi from the existing Poza Rica reinjection units. Each of the three units is designed to compress 26.5 million ft per day including estimated deviation factor.

This line is now under construction and is targeted for completion in 60 days. It is slated to carry 50 million ft per day upon completion.

Here is an interesting angle to the whole thing which has not escaped the PEMEX engineers and management:

There is now in operation a 22-in. low pressure line between San Andres and Poza Rica. Installation of the new 4600-lb line will mean that there is a two-way highway between these two fields.

I will try to explain: After the oil produced at the San Andres field is separated, the repressuring will permit higher production of oil and corresponding higher production of gas.

This gas will be collected (at San Andres) and sent back to the treating facilities at Poza Rica where sulfur and gasoline are removed.

Then the residue gas is returned to San Andres for reinjection.

The low pressure-line carrying the sour gas north east from San Andres to Poza Rica is a 22-in. job, built to start at 200 psi and later go up to 400 psi.

This same gas, after being treated, will be returned via the new 4600-lb line for repressuring the same field from which it originated.

You will note that it is pressured up at the extraction plant, and fed from the end of the line directly into the San Andres field at about 4300 psi.

At the start, San Andres will take gas from Poza Rica, but after completion of the plan, this will not occur, as San Andres will produce its own injection gas as outlined above.

All in all, an extremely ingenious way of solving a problem!

PEMEX management has been most diligent in keeping abreast of the latest developments and in maintaining their existing facilities in top operating condition. They have consistently called on the equipment supplier's top engineers to work with them in achieving this goal. This includes a firm training program for pipeline operators and maintenance men.

Typical of the calibre of the North American engineers who are on call at the desire of PEMEX managment is Vern Ford of Clark Bros. who has had over 30 years experience in the compressor station field, and has many times visited PEMEX installations during the past 14 years.

I was impressed by the fact that the PEMEX organization have the men of integrity, the brains and the ambition to really do a first class job of developing their resources. They are not starry-eyed dreamers with the idea of obtaining gifts from abroad for impractical projects. Rather, as described in this article, they are hard-headed practical men who prefer to work out their own problems and design their projects to fit within their resources, and look for outside financial help only for those things which they most absolutely have to have to complete their work.

I am quite optimistic about their future. ■

Vinton Long (standing) is questioned by Alfonso Barnetche, exploitation manager for Pemex.

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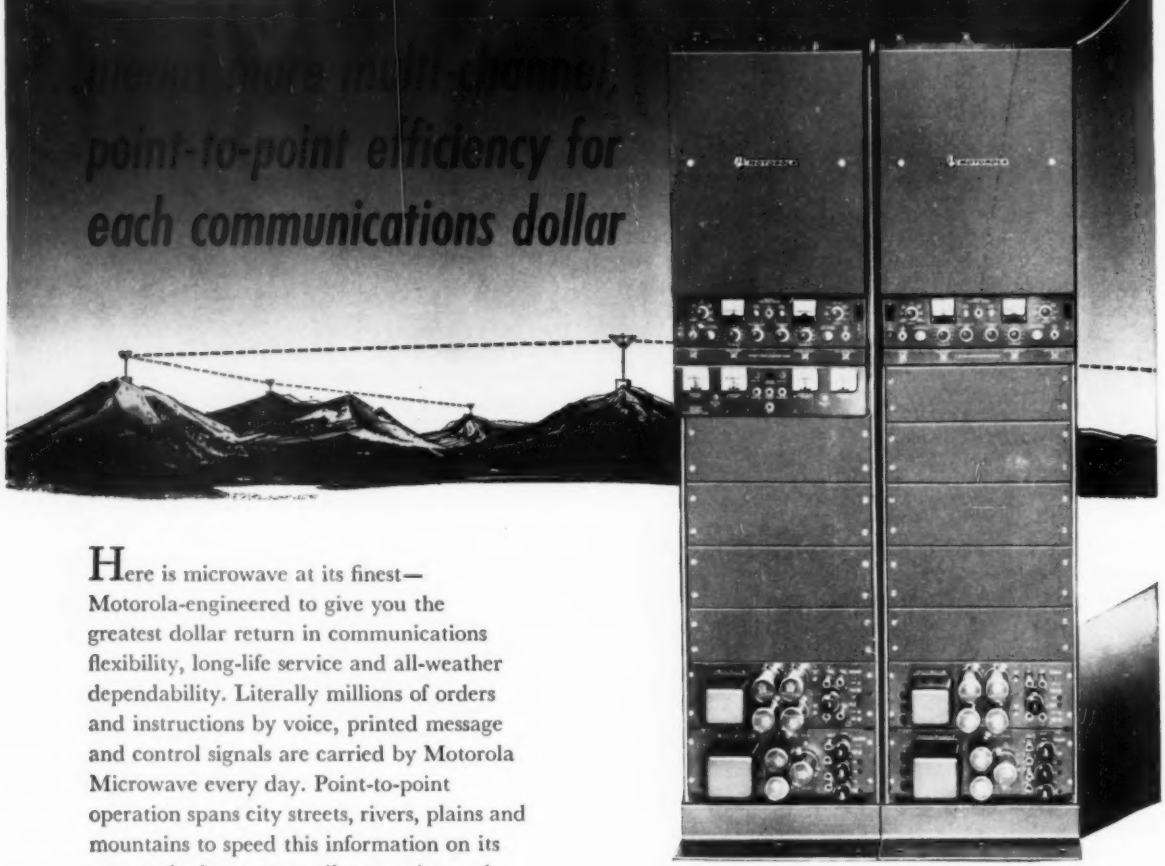

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GAS Pipeline People

H. D. McHENRY, vice president, secretary and general counsel of Southern Natural Gas Co., has been elected executive vice president. McHenry first joined Southern Natural in 1936 in the New York offices. He moved to Birmingham in 1941.

DR. GUS E. MONTES has joined Northern Natural Gas Co., Omaha, as technical director of the gas products development department. Before joining Northern, Dr. Montes was chief technologist of the U. S. Industrial Chemicals Corp. at Tuscola, Ill.

Three vice presidential appointments were made by Midwest Piping Co., St. Louis. NORMAN B. CHAMP JR. is vice president, administrative; E. B. STOLLE, vice president, Pacific division; and T. R. TAYLOR JR., vice president, eastern division.

JAMES J. TREBILCOTT and ROBERT M. HOFFER are vice presidents of Michigan Wisconsin Pipe Line Co., Detroit. Trebilcott also was elected to the board of directors and reappointed manager of operations. Hoffer also became a vice president of American Louisiana Pipe Line Co. He has been controller of the two affiliated companies since 1957. He retains that post.

G. L. ALDRICH is distributor-dealer sales administrator for mobile radio equipment produced by Bendix Radio's Industrial Electronics Products group.

A. E. HAMALAINEN has been named superintendent of compressor station 5 at Eunice, La., by Transcontinental Gas Pipe Line Corp. H. E. MELTON succeeds him as superintendent of station 36 at Chatham, Va.

EARL MARTIN is succeeding R. H. DALE as branch manager of Cooper-Bessemer Corp.'s Houston office. Dale is retiring after more than 25 years with the company. Martin has been assistant branch manager. Cooper - Bessemer also announced the appointment of LEOPOLD A. FFRENCH to the C-B International Corp. in New York.

C. R. JONES has been promoted to general manager, Cooper-Bessemer of Canada Ltd. Jones, vice president and western district manager, also was named to the board of directors of C-B of Canada.

Walworth Co., New York, has appointed CHARLES H. CREASSER vice president in charge of manufacturing. Engineering director is JOHN ALICO. LEO E. GARLAND has been named manager of Walworth's western division, headquartering in Chicago.

JACK L. ASHBY has been named president and chief executive of Kaiser Steel Corp., Oakland, Calif. He has been vice president and general manager since 1948.

Two departments of General Electric's industrial electronics division have made key managerial appointments in their sales staffs. L. R. SHEELEY, manager of mobile radio equipment sales for the communication products department, is now manager of sales for the computer department in Phoenix. KENT J. WORTHEN, manager of product planning for point-to-point communications, has been named national manager of mobile radio equipment sales for the communication products department at Lynchburg, Va.

DELL S. NUNALLY has been named division sales head of the newly formed pipeline division of Continental Tapes, Cayce, S. C. Through this new division, Continental Tapes will manufacture and market pressure sensitive plastic protective coating tapes. President of Continental is Guy F. Lipscomb Jr.

GEORGE F. HABACH, currently vice president-engineering of Worthington Corp., has been named to the newly created post of vice president-administration. Rear Admiral ALBERT G. MUMMA (ret.) succeeds Habach. In his new post, Habach heads Worthington's staff activities of comptroller, employee and public relations, engineering, manufacturing, marketing, purchasing and taxes.

General Electric Communication products department has moved its five-state southeastern regional two-way radio sales office from Atlanta, Ga., to Tallahassee. J. W. BRYANT heads the new office. M. C. MCRAE, G-E's northern Florida district mobile radio sales manager, also headquarters in Tallahassee.

Several appointments have been made by Polyken Sales Division, the Kendall Co., as a result of its expanding sales and service program. ALFRED J. SPIRY, formerly

Continued on page 139

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Telemetering matched in performance with famous Foxboro instruments — that's the Foxboro Teletax Telemetering System.

Through use of impulse-duration signals, Teletax electrically transmits measurements of a remotely-located variable to the central control station. Here, the Teletax receiver records the duration of impulse, which is directly proportional to the measured variable.

The Foxboro Teletax System is noted for its simplicity, its versatility, and its high sustained accuracy. For a transmission medium, it can use either AC or DC, an audio frequency carried on a transmission line, or radio or microwave impulses. Sustained accuracy is 0.5% of full scale.

TELETAX RECEIVERS

Teletax receivers include: Single or Dual Receivers; Multi-Record Receivers for recording up to 6 separate measurements on one chart; and Teletax Receiver-Controllers for automatic operation. And the Teletax signal can be simply converted to digital information.

TRANSMISSION LINK

With Foxboro's Teletax Telemetering System, you can use the most advanced transmitting techniques: two wire lines, power lines, radio or microwave. As many as 25 different signals can be handled in each direction, simultaneously.

TELETAX TRANSMITTER

The Teletax Transmitter houses either one or two standard Foxboro measuring elements — plus the Teletax transmitting mechanism. It will transmit to a control center hundreds of miles away just as easily as to one nearby. It also indicates or records locally if desired.

The Teletax Transmitter needs no periodic maintenance whatever, while the receiver requires only occasional oiling. And the receiver has a minimum of mechanical components to wear — no clutch to slip or jam.

Foxboro Teletax Systems are now in wide use on natural gas systems, water works, oil fields, power plants, steel mills, etc. Write for Bulletin 17-11C — it gives all the details. The Foxboro Company, 348 Norfolk Street, Foxboro, Mass.

*Reg. U. S. Pat. Off.

FOXBORO

REG. U.S. PAT. OFF.

TELETAX TELEMETERING

Foxboro urges you to attend the I.S.A. Show in Chicago, Sept. 21-25

Edited by FRANK CHAPMAN

The Iron Curtain

Where the transmission lines stop and the distributors take over

By F. VINTON LONG

FIRST off, I would like to say that there ain't really any iron curtain, that the long-haul men and their customers have common interests and just get along fine.

That is, they *could* get along fine if they would only talk to each other.

What I wish right now is that they would talk about the use of computing meters or flow meters to sell gas. And further, to bring out the information in digital form so that it can be transmitted somewhere with accuracy.

And this data should be used for dispatching and for customer billing.

Now the reason there is so little talking going on is, I'm afraid, largely the fault of us long-haul men. We say, "The reason we use 1935 methods is because the distributors won't accept 1959 or 1960 concepts."

I say that just isn't so.

All we need is a little conversation, and then someone to start the ball rolling after the conversation.

About all most of us have done up to now is talk about it.

At the AGA transmission conference tele-control symposium in Dallas on May 18, I came out and said that we transmission men were dragging our feet and placing the lag on our customers.

Two of our customers were at this session, and both said that their companies would gladly accept any form of measuring and billing that could be mutually agreed upon. And they were level-headed men and had no axe to grind nor an urge to try something new just to be different. They were Edlow S. Bance of Long Island Lighting Co. and John Boniface of Public Service of New Jersey.

We need to measure and sell on a real standard cubic foot, or therms, or weight, or standard something, to make it easier.

A particularly pesky problem is the design of a sales station with a wide variation of flow. Right now we must use a battery of orifice meter runs to give us accuracy throughout the operating range. Right there we run into a lot of extra piping, extra controllers, extra metering and extra tele-control equipment which soon runs up into a lot of money.

Also headaches.

All of this mess could be eliminated *and the cost cut in half* if we would use a flow meter.

You can see this by *Fig. 1.*

Don't forget that new equipment can now go to 30 to 1 or even 400 to 1 flow ratios and that means we have it made!

And we would obtain an extra dividend because the one meter would:

1. Serve as a flow control for the transmission line dispatcher;
2. Transmit identical information to the customer for his use;

METERING STATION DIAGRAMS

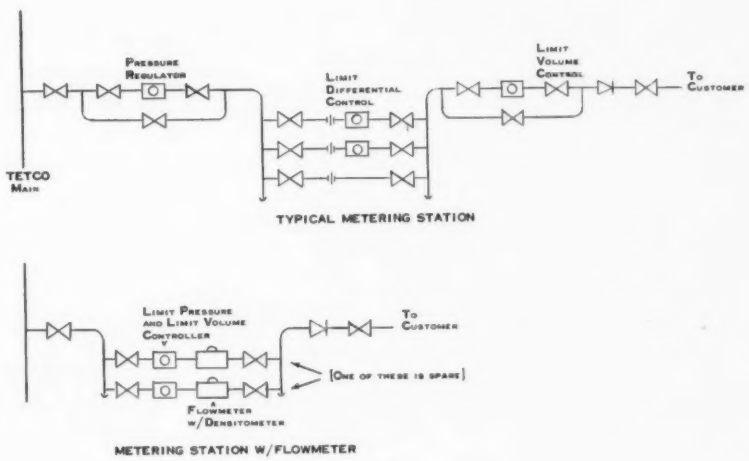
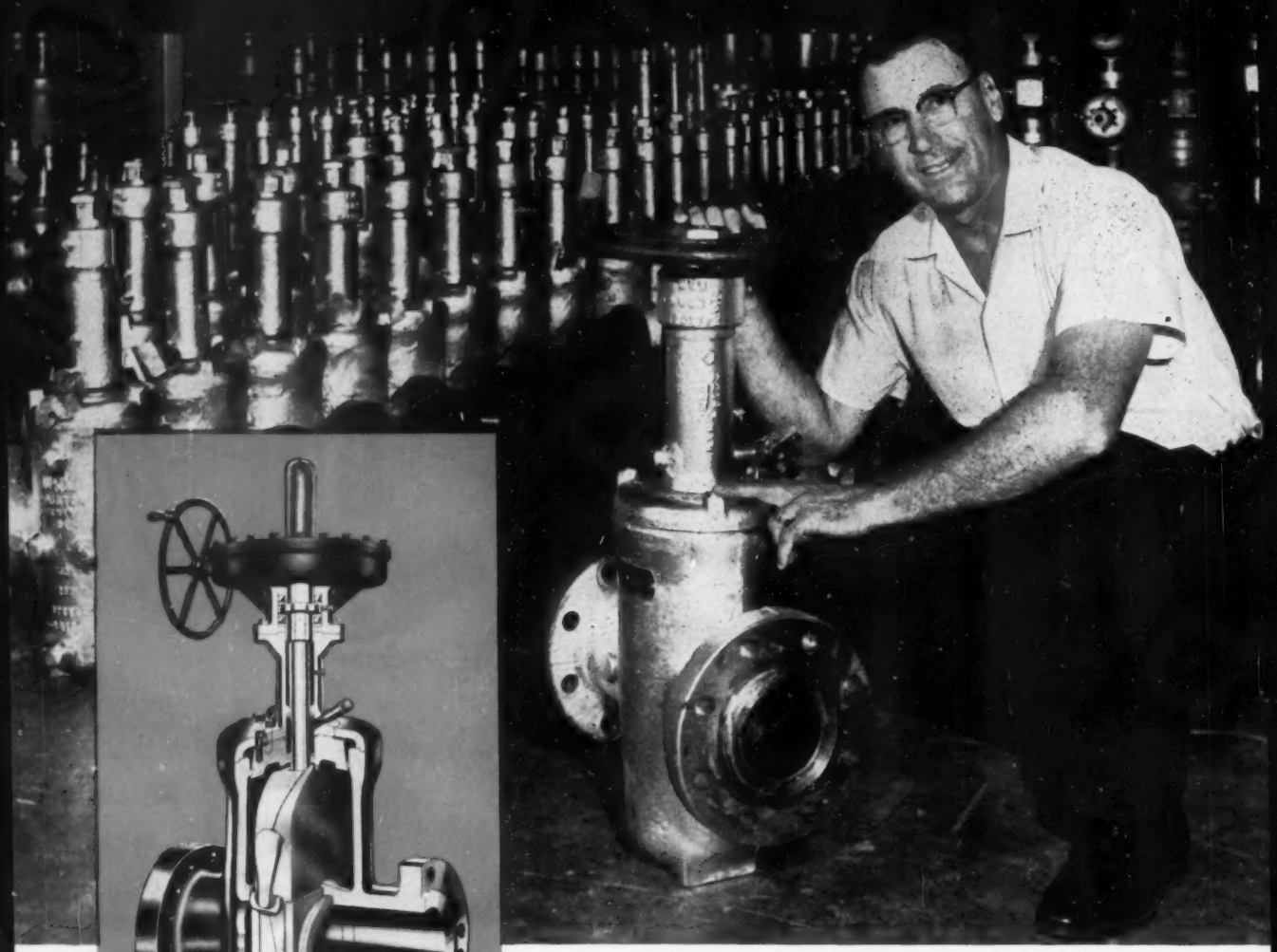
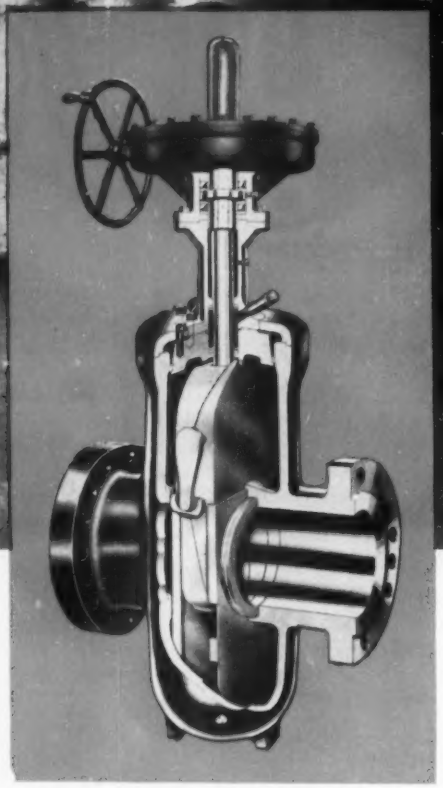


Fig. 1





Leverlock* Gate Valves — A W-K-M Exclusive

W-K-M Pipeline Valves open **free** and close **easy** against any pressure within their rating. An exclusive centralizing mechanism—found only in W-K-M Leverlock Valves—positively holds the gate and segment assembly in a retracted position so that it will move freely between the seats when the valve is being opened or closed.

When the gate and segment reach the fully open or fully closed position—and only then—the centralizing mechanism releases to permit the gate and segment to expand and seat tightly against the upstream and downstream seats.

On Hand

Order 2-inch through 12-inch sizes from your supply store. Larger sizes to 34-inch available on special order from factory. Sizes 6-inch and larger are Leverlock Valves. ASA 300 pounds to ASA 1500 pounds.

*Trademark of ACF Industries, Inc.

The W-K-M® Through-Conduit Gate Valve is your valve

W-K-M's creative engineering designed this valve to solve *your* pipeline valve problems. It has been produced to meet your specifications for strength, long life and economy. Before it reaches you, it will have undergone rigorous and thorough testing.

That's why field men recommend the W-K-M Through-Conduit Gate Valve, why engineers specify its use. Its reputation inspires confidence—its dependability has been proved in service throughout the world.

It's *your* valve; specify and use it. *Write for Catalog 300:*
W-K-M Division of ACF Industries, Incorporated,
P. O. Box 2117, Houston 1, Texas

W-K-M 40 SERVING INDUSTRY YEARS

3. Make possible automatic billing;

4. Make available feedback or closed loop facilities for automatic pipeline operation;

5. Eliminate daily chart changing (circa 1925);

6. *Save us money.* (I hope management sees this.)

If we were of the nervous type we would use two flow meters, just in case. However, there is no real cause for apprehension because, believe it or not, these little machines are working every day. So we don't have to revert to that let-Joe-try-it attitude. The output of these flow meters would read out in digital form and could be safely transmitted anywhere without error. If you were worried about communication breaks you would use something like Control Corporation's Type TM-16 which would keep the intelligence stored until the communications channel was back in business again.

So, you see, there is no risk. What can you lose?

Now, there comes up the thought that we can't do this thing because

1. It does not conform with AGA standards that outline the use of orifice meters for billing;

2. Most of the sales contracts spell out the use of orifice meters.

To answer the first question, I'm sure that AGA, which after all is a group composed of you and me and a lot of gas people, including management, would be the first to accept the march of progress. And, even if the use of something like flow meters for billing had not yet been spelled out, these men do not attempt to dictate what might be agreed between two companies.

The second bugaboo was answered quite simply by a distribution executive, John Boniface. He said, "Change the contract." That's no problem if it's good for both parties and does not hurt the public.

There really is no problem. ■

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people • *Continued*

from page 135

D. W. McCabe
Polyken

A. J. Spiry
Polyken

W. K. Warren
Transwestern

F. C. Nicholson
Northern

south central sales representative for Polyken, is now in charge of the Polyken sales department, international division, in Chicago. DONALD W. MCCABE, formerly associated with Polyken in Canada, has joined Polyken protective coatings in Chicago as assistant merchandise manager. New regional representatives include: JAMES C. O'BRIEN, Midwest representative, Chicago; ROBERT L. TONEY JR., southwest; WILLIAM F. LECHLER, north central; M. LAMAR BOWDEN, southeast; JOSEPH F. BATTEER, JOHN M. MCGIVERN, and JAMES O. KIRCHER, northeast, south central and Gulf South, respectively.

Coastal Transmission Corp., Houston, has added three men to its staff. HARRY E. OTELL JR. is chief petroleum engineer. He formerly was with Lone Star Gas Co. and Trunkline Gas Co. HARVEY G. DUDMAN is superintendent of communications and cathodic protection. ROBERT C. IMLER is right-of-way manager. BOBBY E. CROW is ad valorem tax man. He formerly was with Texas Gas Transmission Corp.

F. C. NICHOLSON is a newly elected vice president of Northern Natural Gas Co. Nicholson heads up the gas products development department of Northern in addition to serving as vice president of Helex Co., Northern subsidiary.

Three executive promotions are announced by Black, Sivalls & Bryson Inc., Kansas City, Mo. CHARLES H. MYERS, vice president and manager of the oilfield equipment division, is industrial relations vice president. FLOYD C. MYERS, vice president and manager of oilfield sales and service, is Houston vice president. PAUL BARTLEY, vice president and general manager of BS&B Ltd., Edmonton, Canada, is manager of the oilfield equipment division in Oklahoma City.

W. K. WARREN, chairman of the board and chief executive officer of Warren Petroleum Corp., has been elected to the board and chairman of the board of Transwestern Pipeline Co. JOHN R. MCMILLAN, president of Monterey Oil Co., was elected vice chairman. J. R. BUTLER is chairman of the executive committee and secretary and treasurer of the company.

F. C. Myers
BS&B

C. H. Myers
BS&B

Paul Bartley
BS&B

H. G. Dudman
Coastal

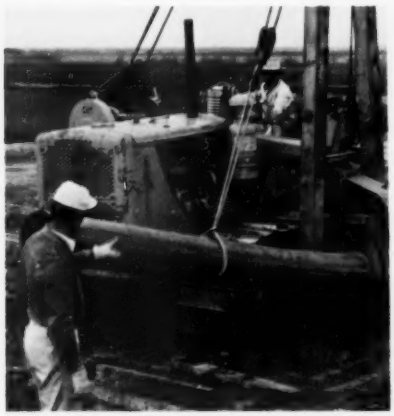
H. E. Otell, Jr.
Coastal

R. G. Imler
Coastal

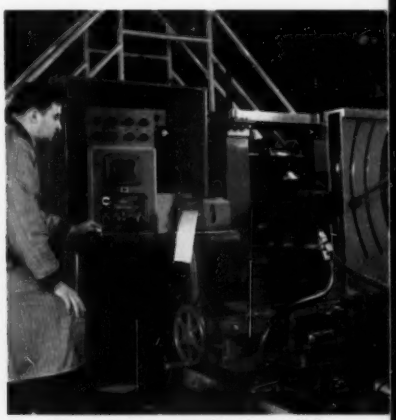
Superior quality 12¾" O.D. J&L Electricweld line pipe was used for 17 miles of this Northern Oklahoma Gas Company line from Cherokee to Ponca City. The line will serve the towns of Ponca City, Perry and Newkirk, Oklahoma, and area industries. J&L line pipe is available in sizes from 6⅝" to 12¾".

General Contractor:
O. R. Burden Construction Corporation, Tulsa, Oklahoma
Contractor for coating and wrapping:
Secrest Pipe Coating Service, Tulsa, Oklahoma

Pipe laying operations with this J&L Electricweld line pipe are fast and efficient. Weldability is excellent. Pipe is 29.28 pounds per foot, .219" wall, X-46 grade.



Reliable field performance is assured because every length of J&L pipe undergoes a specified hydrostatic pressure test which proves its dependability under sustained and surge pressures.



This ultrasonic tester provides immediate pictures of weld soundness in all J&L Electricweld line pipe. It is one of the most advanced control devices in pipe-making.

Quality control at J&L pays off on a job at Cherokee

Every length of J&L line pipe passes over 50 quality tests before it enters the field

Total quality control of J&L Electricweld line pipe is maintained through more than 50 control measures and tests on every length of pipe.

Crush tests assure weld strength and steel quality. A modern ultrasonic device probes soundness of the weld. All joint ends are magnafluxed to assure freedom from flaws. Every length is full-pressure tested under specified A.P.I. or A.S.T.M. hydrostatic test requirements, both in time and degree of pressure. These are a few of the stringent controls that assure complete dependability of J&L Electricweld line pipe.

It pays to specify plant-tested, field-proved J&L Electricweld pipe for your transmission, distribution or gathering lines. Write for J&L's new bulletin.

Jones & Laughlin Steel Corporation

PITTSBURGH, PENNSYLVANIA

GAS • PIPELINE NEWS

Oral arguments under way on Transwestern line

Transwestern Pipeline Co.'s $191.7 million plan to supply 300 MMcfd to southern California was okayed by an FPC presiding examiner. Oral arguments on Docket G-14871 et al got under way on July 23.

The plan covers some 1809 miles of line and 40,890 hp in compression. It originates in the Panhandle-Hugoton and West Texas-Permian Basin areas and terminates at the Arizona-California border, near Topock, Ariz.

Pacific Lighting Gas Supply Co. will buy the gas from Transwestern and resell it to its affiliates, Southern California and Southern Counties Gas companies, Los Angeles.

Fourteen independent producers and one pipeline company, Cities Service Gas Co., also were certificated. Examiner Harry Frazee denied the pleas of California's PUC to limit the initial gas price to levels below those proposed. He said there was no substantial evidence "to rebut the presumption that the initial prices . . . are just and reasonable."

Frazee said that Transwestern's gas and new gas supplies proposed by El Paso Natural are "urgently" needed to meet the heavy actual and expected growth in peak-day firm demand.

He said the 45-cent-per-Mcf delivered price of the gas would be economically feasible for the southern California companies. They are paying from 29¼ to 29¾ cents per Mcf for gas bought from El Paso and local sources. With the Transwestern supply, they would have an overall delivered gas cost of 33 to 33⅓ cents.

Frazee also rejected FPC staff claims that Transwestern's gas supply couldn't support its project. He noted that the staff said Transwestern had a 13-year supply. And, he found it reasonable to conclude that Transwestern's reserves would rise steadily from already-dedicated leases and from future purchases. He said that Transwestern was able to acquire a vast reserve of gas, together with the dedication of a large amount of potential acreage, at an average cost of 19.36 cents per Mcf. "This," he said, "is an accomplishment of some proportion, for no pipeline company in recent times . . . has been able to assemble such a quantity . . . of gas at such a low average initial cost."

Both the FPC staff and the California PUC gave evidence designed to show that the proposed initial prices were too high. However, Frazee declared that initial prices "fixed, as here, by well-known producers and a competent purchaser become the product of expert judgment and therefore carry the presumption of justness and reasonableness."

Southern Counties-Southern California Gas companies are relocating 2600 ft of their Texas pipeline. The move had to be made because of plans for Carbon Canyon dam, a key flood control project in California's Orange county. Harry Gavin (right) SoCal project superintendent, goes over plans with Cleo Eatherly, contractor's foreman.

Rayne approval adds huge reserves to TET system

The way is paved for Texas Eastern Transmission Corp. to add about 1 trillion cu ft to its natural gas reserves. Approved by FPC was Texas Eastern's plan to move an added 101.6 MMcf daily from Rayne field in Acadia parish, La. The okay covers Dockets G-12446, 12447, 12432.

Temporary certificates were issued earlier for most of the facilities. Exceptions were those attaching the Rayne reserves. Cost of the project is $49 million.

Texas Eastern will build 100 miles of 30-in. loops, 22 miles of 14-in. supply lines. Some 185,070 compressor hp is slated for Kentucky, Louisiana, Mississippi, New Jersey, Ohio, Pennsylvania, and Tennessee.

The Shreveport-based company first planned to buy gas from the producers. An amended filing proposed acquiring leasehold interests in the field. Buyer of the leaseholds is a newly organized subsidiary, Louisiana Gas Corp. The producers will get $14.4 million in cash. Another $121.9 million in notes will be issued to the producers, payable over a 16-year period. Added to this total is $46.6 million to be paid for the royalty and minority interest portion of the leases.

Texas Eastern's unit cost of the gas, estimated at 20.59 cents per Mcf, was 2.01 cents less than the initial price proposed by the producers.

Southern Natural's major expansion okayed

Southern Natural Gas Co.'s $55.2 million construction plan was sanctioned by FPC (Docket G-9892).

Also covered was South Georgia Natural Gas Co.'s increased firm service to 15 present customers, new sales to nine Georgia towns, and interruptible sales to three industrial users.

New facilities will increase Southern's top delivery capacity from 990 MMcfd to 1.3 billion. About 590 miles of loops will be built. New laterals will go into gas fields in southwest Mississippi and southeast Louisiana to take contracted gas reserves. Also covered are 8624 hp additions.

Ten producers are involved in the gas sales. Recoverable reserves in Louisiana and Mississippi are estimated at 830.1 billion cu ft.

PG&E to get more gas from El Paso

El Paso Natural Gas Co. wants to send an additional 100 MMcfd into Pacific Gas & Electric's system (Docket G-15696). El Paso has asked FPC to approve the $47.2 million plan.

New facilities include 118.7 miles of 30-in. mainline loops; 24,500 hp in new and existing stations. Field facilities cover 344 miles of 2⅜ to 20-in. lines; 12,900-hp additions; and a 25 MMcfd increase at the Chaco gasoline plant. The work would be done in Arizona, New Mexico, and Texas.

Delivery would be at the existing point on the Arizona-California border near Topock, Ariz.

El Paso expects to get additional gas from Terrell county, Texas; Lea county, New Mexico; and the Bisti field and Tapacito areas of San Juan county, N. M.

Contractors working on Midwestern line

Contracts have been let and work is under way on Midwestern Gas Transmission Co.'s system from Portland, Tenn., to Joliet, Ill.

Contractors and their mileage for the 350-mile, 30-in. line are: Grayco Constructors Inc., 51 miles, Portland to Cromwell, Ky.; Sharman, Allen, Gay & Taylor Inc., 43 miles from Cromwell to the Ohio river; Panama Inc., 53 miles, Ohio river to White river near Algiers, Ind.; Majestic Contractors Ltd., 53 miles, White river to Wabash river near Terre Haute; Bechtel Corp., 148 miles from the Wabash to the terminus near Joliet. Six river crossings are involved: the Ohio, Wabash, Green (Kentucky), White (Indiana), and the Kankakee and Des Plaines, both in Illinois.

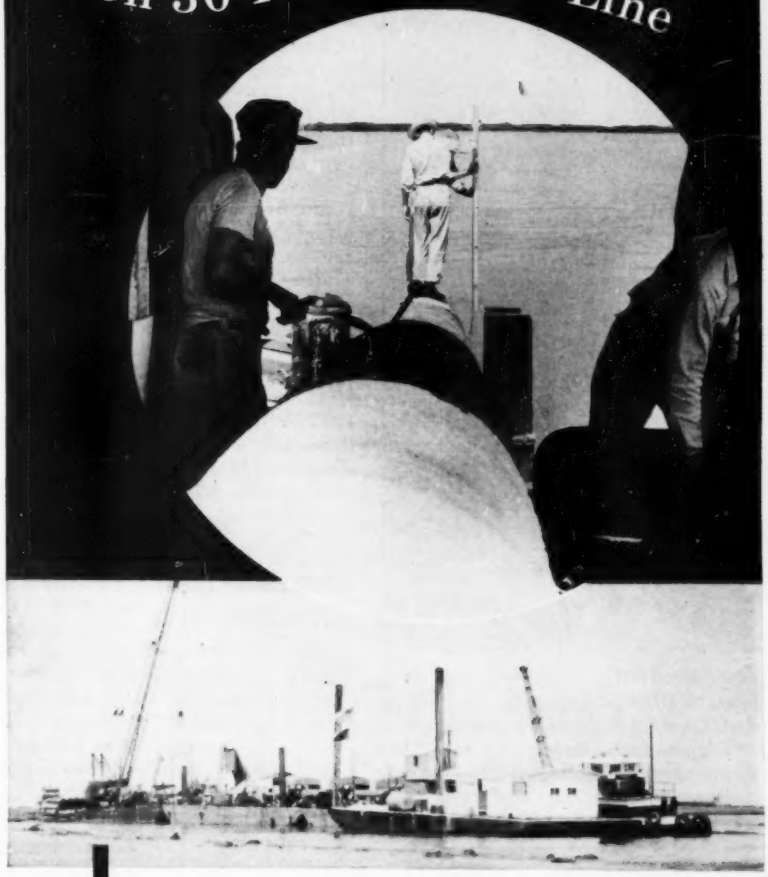
Houston Contracting Co. is working on a 6000-hp compressor station at Portland.

Buy Texas Gas Corp.

Texas Gas Corp., Houston, has been acquired by a group headed by Carl M. Loeb, Rhoades & Co., investment bankers of New York; Godfrey L. Cabot Inc., Boston; and Russell M. Riggins, president of Texas Gas.

Texas Gas has 500 miles of transmission lines in Texas. It transports 325 MMcfd from producers in Chambers, Galveston, Jefferson, Liberty and Orange counties, Texas.

RIGID SPECS EXCEEDED
on 30-Inch Marine Line



On Tennessee Gas Transmission Company's new 30-inch line across the Mississippi River Delta a high minimum radius of curvature was specified for laying the pipe. Houston laid the heavy, cement-coated pipe while maintaining a radius exceeding the specification by a full 20%. Houston Contracting's enviable reputation for quality construction has been built on performance such as this.

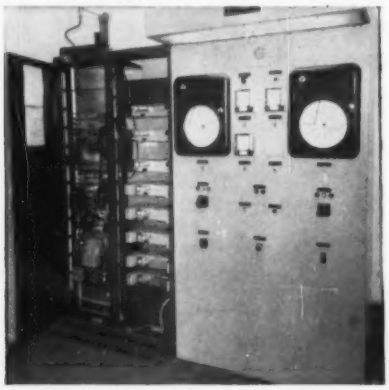
HOUSTON CONTRACTING COMPANY
2807 BUFFALO SPEEDWAY
HOUSTON 6, TEXAS

Laurence H. Favrot
R. P. Gregory
H. J. Muckley
Geo. A. Peterkin

OIL • GAS • PRODUCTS • WATER PIPELINES
104

Transmitting

From its office in Gainesville, the Georgia Gas Company controls an Ingersoll-Rand SVG gas-engine compressor 15 miles away by microwave signals. This control panel indicates operating conditions, and contains controls which are linked by the microwave transmitter (at its left) to a receiver and control panel at the compressor station 15 miles away (see opposite page).



Ingersoll-Rand

6-894

Northern plans Redfield deliveries

Northern Natural will launch firm gas sales from its Redfield storage area in the 1959-60 heating season.

To meet this year's requests for more gas, Northern plans to increase system salable capacity by 30 MMcf daily. Total capacity will then be about 1.27 billion cu ft per day.

Recent large scale testing of the reservoir was a success. Some 50 MMcf per day was withdrawn for 120 consecutive days. Testing is continuing to further develop the storage field.

To supply the added gas to present customers, Northern will spend $2 million. Included: 8 miles of 30-in. mainline loop north of Ventura, Iowa; 22 miles of branch lines near Marshalltown and Griswold, Iowa; and a 2000-hp compressor unit added to the Sunray, Texas, station.

FPC must guard against excessive rates

The FPC was ordered to guard against excessive rates in considering new gas service applications from independent producers. In issuing the order, the Supreme Court unanimously upheld a pair of lower court orders.

Upset was the FPC's policy of allowing new gas sales before approving rates to be charged. FPC's reasoning: new gas service shouldn't be held up while lengthy rate hearings are under way. They can be dealt with later.

Justice Clark's majority opinion does not require a full rate probe before new service can be approved. But, it directs the commission to take steps to prevent excessive rates on new gas sales.

This apparently means FPC—without passing on the reasonableness of proposed initial rates—must reject those that are excessive on their face. The commission can either refuse to issue certificates because of high rates or it can attach rate ceilings to certificates issued.

Panhandle allocation gets go-ahead

Panhandle Eastern Pipe Line Co.'s allocation of 157 MMcfd among its customers in the Midwest was approved by the FPC.

Included in the volume is 127 MMcfd formerly sold to Michigan Consolidated Gas Co. Also, another 30 MMcf made available by upgrading some compressor stations.

Here is how the plan works: The customer's average present winter contract demand and its first-year's needs are divided by its space heating saturation. Estimates show Panhandle's customers will use the full 157 MMcf increase in the 1959-60 winter. They will use 39.2 billion cu ft annually.

Under Panhandle's storage gas rate, customers will use 18.5 billion cu ft per year. This makes a total of 57.7 billion under the two programs, substantially equal to the 57.3 billion cu ft which Panhandle has for distribution annually.

Twenty thousand tons of 36-in. pipe for the third Calumet line of Chicago District Pipeline Co. was brought by barge from Houston to storage sites near the right-of-way. The $17 million line, running for about 60 miles from near Joliet, Ill. to Chicago, is expected to be completed this fall. It has a designed capacity of 557 MMcf daily.

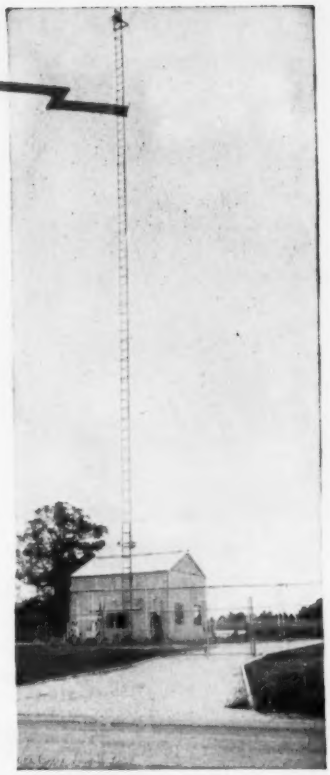
The IR gas-engine compressors that "THINK FOR THEMSELVES" also respond to "TELEPATHY"

...Georgia Gas Company's new booster station is controlled by microwave from 15 miles away

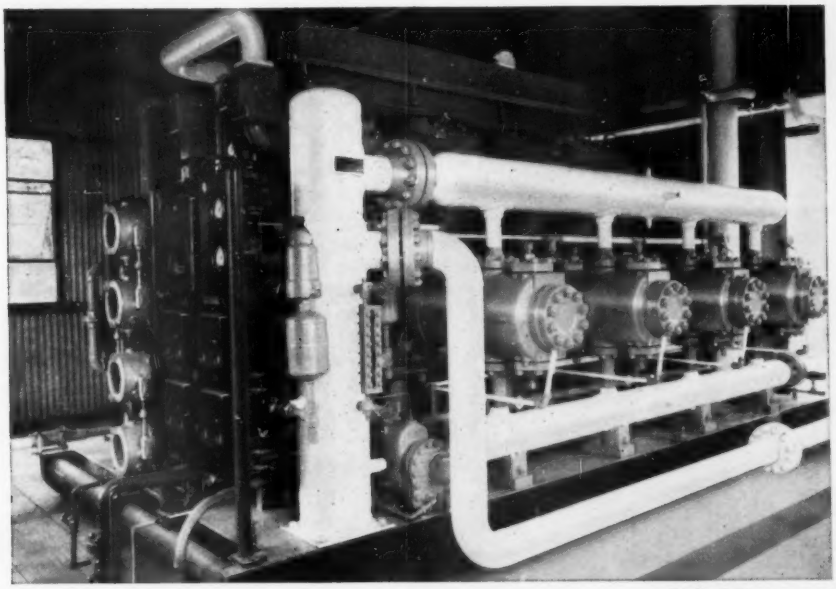
At Georgia Gas Company's office in downtown Gainesville, a man turns a knob on a control panel and a radio signal is beamed from a tower outside the building. Fifteen miles away, a 440-hp Ingersoll-Rand SVG gas-engine compressor plant starts itself, brings itself up to speed, and puts itself on stream delivering gas to Georgia homes and businesses. All the time it is running, the unit is monitoring its own operation and protecting itself from harm.

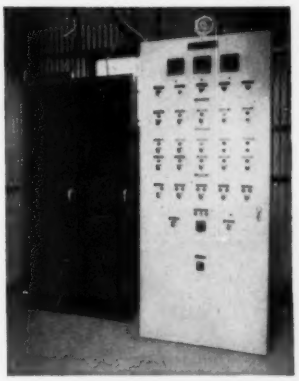
This installation is only a sample of the new things happening in the pipeline field, and this SVG is only a part of the Ingersoll-Rand compressor family that is meeting the challenge of new developments. I-R 4-cycle V-angle engine-compressors are ideal for automated and remote-control installations, due to inherently greater operating *stability* through a wide range of speeds and loads.

Ingersoll-Rand has supplied millions of horsepower of heavy-duty compressors for every possible service, and builds many types of other equipment for the pipeline industry. Call your I-R representative now for more information.



Receiving
Radio signals received by this panel are converted to impulses which start or stop the Ingersoll-Rand SVG gas-engine compressor shown at left below. With the panel, the compressor automatically monitors its operation—it takes its own temperatures, gauges its pressures, watches its lubrication and protects itself from damage. And if any abnormal condition occurs, it warns its operator and shuts itself down.





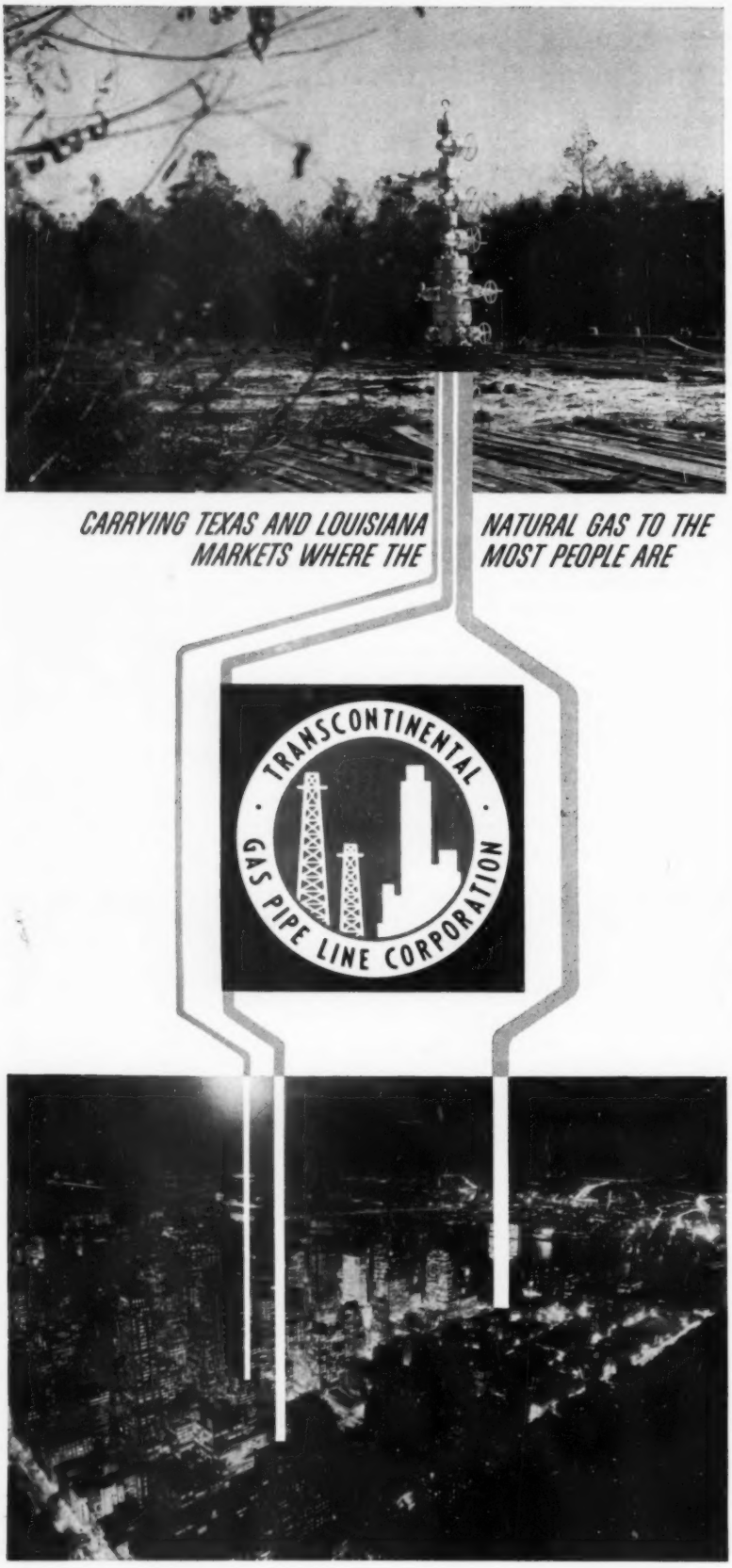
Only I-R compressors have CHANNEL VALVES

Known for high efficiency, quiet operation and exceptional durability. Entirely different. Each valve is a combination of straight-lifting stainless-steel channels and leaf springs, with trapped-air spaces which cushion action, prevent impact.

Ingersoll-Rand

6-894

11 BROADWAY, NEW YORK 4, N.Y.



Engine wear studied

Results of a study of the relationship between equipment wear and concentrations of metal in lubricating oil have been published.

The report, prepared by the AGA, suggests study of lubricating oil used in pipeline compressor equipment to detect excessive engine and compressor wear prior to failure in service.

Research was conducted by the Institute of Gas Technology under sponsorship of AGA's PAR plan.

Titled "Wear in Pipeline Engines and Compressors: Methods of Measurement," the report is available from the AGA, 420 Lexington Ave., New York 17, for $1.50.

Sale okayed despite opposition

Sunray Mid-Continent Oil Co. can sell gas from southern Louisiana's Point Au Fer field to Transcontinental Gas Pipe Line Corp.

FPC staff and two intervenors wanted a condition attached relating to the outcome of a pending court proceeding. But the examiner said it "would not be reasonable" for him to do so. New York PSC and United Gas Improvement objected to the sale.

The sales contract calls for a starting price of 21.5 cents per Mcf. Price will rise to 29.5 cents by 1974. Gas reserves dedicated to Transco are estimated at 27.4 bilion cu ft. Two other producers are already selling gas from this field at the same price to Transco. The FPC earlier unconditionally okayed this sale. That action, however, is now under court review.

FPC staffers contend that the Sunray sale should be conditioned on the court's ruling on the other two sales. UGI urged the examiner to deny a permanent certificate, or grant the sale subject to the court's ruling on the other cases. New York PSC made the same appeal.

System starts deliveries

First deliveries are being made by Coastal States Gas Producing Co.'s new gas system. Called South Texas Gas Gathering System, it is Coastal States' 32nd gathering operation, and its largest.

Throughput of the 120-mile system is 50 MMcf daily to Texas Illinois Gas Pipeline Co., with an increase expected soon.

Machines also available on rental basis

"NO SHUTDOWN WHILE CUTTING INTO THE LINE with a WmSon-Hillco Tapping Machine. When the tap is completed, Williamson Stopples plug the line temporarily while the flow continues through a by-pass. You can make repairs, replace piping, connect process units and booster stations, install fittings, extend or abandon piping. It's all done without shutdown and **WITH COMPLETE SAFETY!"**

Offering years of research and experience in hot tap operations

T.D. Williamson, Inc.
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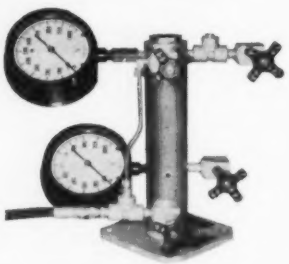
PRESSURE RELIEF
VALVES

REDUCE COSTLY SHUT-DOWN TIME!

HERE'S HOW:

Without removing the valve body from the line, the set pressure and re-set pressure of a Garrett Relief Valve may be checked in a few minutes time. Using the small, light weight Garrett Test Fixture, pressure from bottled nitrogen or other source, and regular hand tools, pressures may be checked or changed by field personnel, without special training.

This is another feature of Garrett Relief Valves which adds to the safety and economy of your operations.



The Garrett Test Fixture is simple to use, light and easy to carry, and completely accurate in operation.

FOR COMPLETE INFORMATION, WRITE FOR CATALOG NO. RV-103-A

USI **Garrett Oil Tools**
Division U. S. Industries, Inc.
P. O. BOX 2427 • LONGVIEW, TEXAS

Tennessee's building in full swing

Largest compressor construction program in company history is set for completion this fall by Tennessee Gas Pipeline Co. Compressor stations, plus major additions to pipeline systems, will cost the TGT division some $69 million.

Delivery capacity of Tennessee's system will reach new highs of over 2.5 billion cu ft on average days, and 2.9 billion on peak days, using underground storage.

The 113,100 hp will go into four new stations and additions to 13 existing stations. It will expand present total hp, now some 641,300 in 39 principal stations, by about 18 per cent.

Contracts for 201 miles of line in Tennessee, Kentucky, and West Virginia have been let. Contractors and their mileage:

Williams Brothers, 70 miles from Portland, Tenn. to Glasgow, Ky.; Western Pipe Line Inc., 72 miles from Glasgow to Stanford, Ky.; H. C. Price Co., 59 miles from Farmer, Ky. to Winchester, Ky., and from Cattlettsburg, Ky. to Hamlin, Va.

New compressor stations are being built at Bay St. Louis and Heidelberg, Miss. (8000-hp each), and at Columbus, Miss. and Collinwood, Tenn. (7500-hp each).

Enlargement of 13 stations in five states are as follows:

Louisiana: Alexandria, 6700 hp; Winnsboro, 4200; Lake Providence, 8100. Mississippi: Isola, 7500; Grenada, 6700; New Albany, 6300. Tennessee: Savanah, 7500; Centerville, 8100. Ohio: Albany, 6800, Cambridge, 7500; Carrollton, 8000. Pennsylvania: Mercer, 2700; Pigeon, 2000.

Line operation okayed

Facilities temporarily okayed for building in January can now be temporarily operated by Michigan Wisconsin Pipe Line Co.

Major construction of 352.9 miles of 24-in. line and 16,560 hp in added compression took place in Kansas, Missouri, Iowa, Illinois, and Michigan. Estimated cost was $31.1 million.

Also authorized was a 20.9-mile, 16-in. loop to Green Bay, Wis.

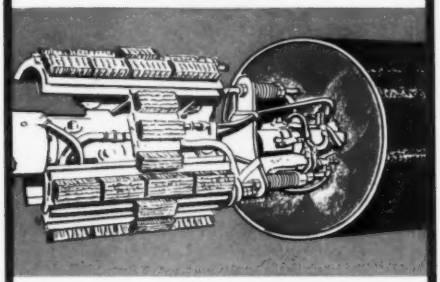
The plan enables Michigan Wisconsin to move 80 MMcf daily from the Laverne field in Harper county, Okla.

Conclusive evidence proves

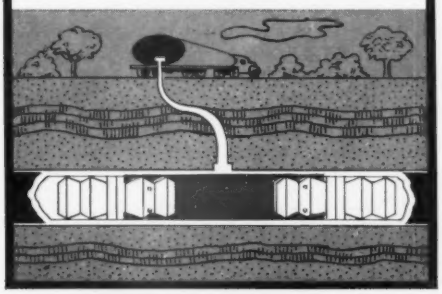
Copon Internal Pipe Coatings Substantially Increase Pipe Line Capacity

Greater efficiency for planned or existing systems

NEW PIPE



PIPE IN GROUND



Tests by major gas transmission firms reveal increased thru-put, lowered compressing costs

Now, proof positive that Copon Internal Pipe Coatings do even more than provide outstanding corrosion protection, reduce maintenance costs, and make possible delivery of cleaner gas products. Recent tests conducted by major gas transmission firms **prove conclusively** that Copon Internal Pipe Coatings improve the efficiency and performance of a pipeline system. The smooth interior finish of Copon Coated Pipe *permits greater thru-put . . .* makes possible *reduced pumping costs.*

These tests are the most recent development in a continuing research program being carried out by the manufacturers of Copon. All Copon Internal Pipe Coatings are developed in close cooperation with pipe line engineers, corrosion engineers, coating applicators and equipment manufacturers. The information gained from this research is available to the purchaser in the form of a complete technical service. **When you specify Copon, you get the performance you pay for.**

● *Ask your Copon representative for complete information on Copon Internal Pipe Coatings . . . and for specific information on increased thru-put and reduced pumping costs.*

Copon®

FOR CORROSION CONTROL

Coast Paint & Lacquer Co.

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Houston 1, Texas

dependable pipe wrap products from Midwestern

Adequate protection of pipelines is a necessity if the operator is to realize the maximum in long, trouble-free life. Midwestern Pipe Line Products Company offers its customers a full line of pipe wraps and coatings backed by 13 years' experience in the pipeline supply industry.

Midwestern's carefully selected line includes **KEYSTONE** Asbestos Pipe Line Felt . . . **KERMAC** Outerwrap . . . **COROMAT** Underground Pipe Wrap . . . **KAPCO** Rock Shield . . . **PERMACEL** Tapes . . . **"GLASFAB"** and **SPEEDWRAP** Pipe Wraps and **SPEEDKOTE** Pipe Coating.

Midwestern also distributes Magnesium and Graphite Anodes, Rectifiers, Pipe Cutting and Beveling Machines, Casing Seals and Insulators, Pipeline Pigs, Line-Up Clamps, Belts, Tongs and other accessory equipment.

Call the Midwestern Man in your area the next time you want to discuss pipe protection problems.

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- Mt. Prospect, Ill.
- Pittsburgh, Pa.
- Oklahoma City, Okla.
- Des Moines, Ia.
- New York, N.Y. (export)
- Caracas, Venezuela

Producer's rates jump from 9 to 17.5 cents

An independent producer's rates have increased from 9 cents to 17.5 cents per Mcf. Mecom Petroleums originally asked for an 18.5 cent price (Docket G-10357). Sales are made to United Gas Pipe Line Co. from Terrbonne parish, La.

Mecom based its cost-of-service on so-called utility rate-making principles and on comparative prices of other sales in the area. Because no better method of computation was available, "effective weight should be accorded the comparative field price," the examiner said. Based on other dealings in the area, Mecom computed weighted average prices of 18.76 cents and 19.37 cents. The variation is due to the size of dedicated reserves and volumes of deliveries. The producer felt that an 18.5-cent price was within the range of current market prices of gas sold under the same or similar conditions.

Panhandle's direct sales approved

An FPC examiner's order lets Panhandle Eastern keep on making interruptible sales to nine midwestern industrial users. Also okayed in Docket G-10699 is an interruptible sale to a new industrial customer.

The nine firms were being served without FPC authorization. Also granted were extensions of orders allowing Panhandle to serve seven other industries.

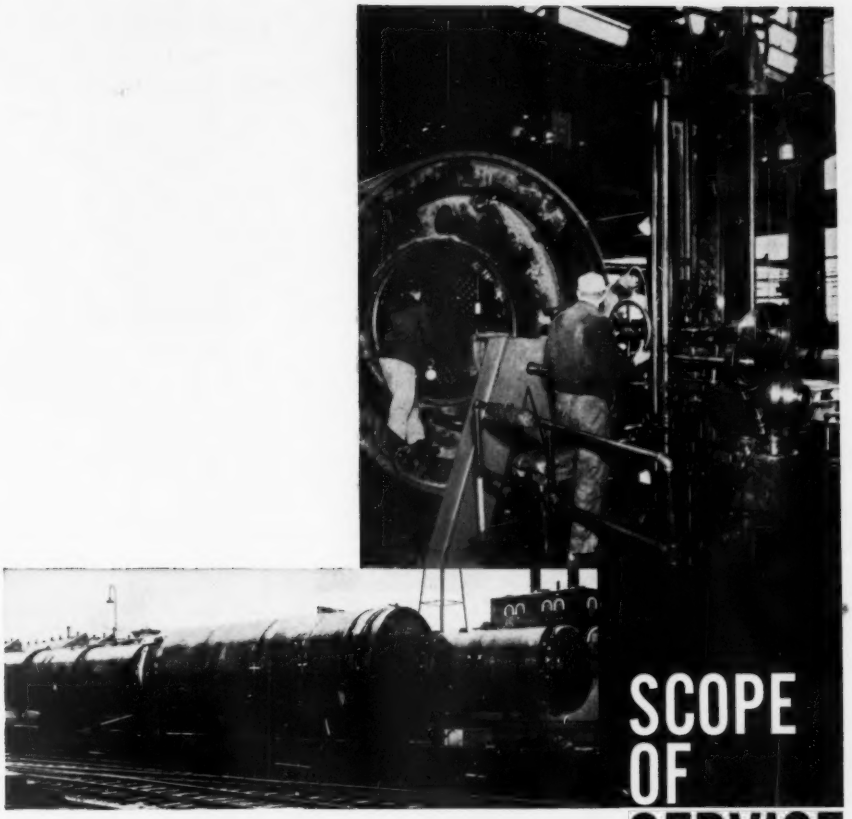
Intervenors in the case either withdrew their filings or were covered by FPC orders. (Michigan Consolidated intervened, but FPC okayed abandonment of Panhandle sales to it last December.)

Presiding Examiner Samuel Binder said Panhandle presented a *prima facie* case for its direct sales. On this basis, along with the withdrawal of the intervenors and the Michigan order, Panhandle is entitled to have all its direct interruptible sale filings granted.

Price coats Mexican line

Harold C. Price, Bartlesville, Okla., has joined with Humberto Lobo of Monterrey, Mexico, to form a Mexican corporation.

Protexa-Price has a contract with Petroleos Mexicanos to apply Hevicote concrete coating to some 43 miles of 24-in. pipe.



SCOPE OF SERVICE

For 43 years the facilities of this large and well-equipped plant for ship and engine building have been employed in building special equipment for oil refineries and chemical plants.

This equipment varies from small tanks to large Fractionating Towers, Stills, Pressure Vessels, Special Machinery, Plate Work, etc. Carbon or alloy steel-annealed and X-rayed.

THE PLANT—Our plant consists of such a variety of shops and machinery that it is unnecessary to sublet when building the type of equipment here listed. The plant consists of:

Boiler and Tank Shops

Steel Fabricating Shops	Machine Shops
Blacksmith Shop	Pipe Shop
Anglesmith Shop	Electric Welding
Coppersmith Shop	Stainless Shop

RAIL OR WATER SHIPMENT—Our plant, located on the Delaware River with piers and deep water to care for sea-going ships, has railroad connections to all points.

We have adequate facilities to handle our work in all its phases and do not have to sublet.

Further information, estimates or proposals on request.

Sun

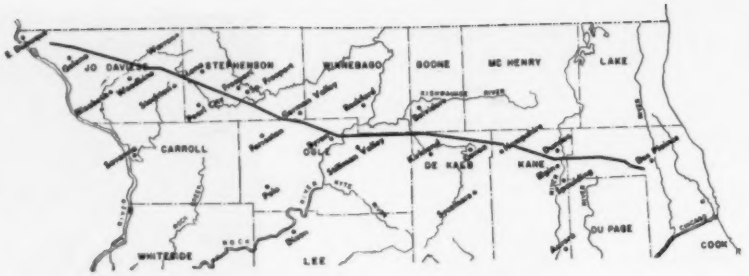
SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE • SINCE 1916 • CHESTER, PA.

SGS • Pipeline Notes

Ohio Fuel Gas Co. is going to build about 37.6 miles of pipeline in Ohio at a cost of $1.7 million. The filing, under Docket G-18359, also calls for abandonment of about 45 miles of small diameter pipeline.

The FPC reversed an examiner's decision, and told Trunkline Gas Co. not to provide gas to the town of Mason, Tenn. The non-industrialized town of 400 doesn't need gas, the FPC said. Its fuel needs are ". . . met by means of liquid propane, coal, oil, wood, and electricity," the order said.



Scheduled for completion by Sept. 30 is Northern Illinois Gas Co.'s 140-mile line from East Dubuque (near Iowa-Illinois border) to NI-Gas facilities near Des Plaines. With the new line, and gas flowing through it, NI-Gas will release gas heat permits to 41,500 customers.

Lone Star Producing Co. bought a 40 per cent interest in the Chapel Hill gas field in east Texas. Purchase price was $2.8 million. Estimated reserves in the field are 80 billion cu ft.

Work is under way on Southern Pipe's pipe building plant in the Hawaiian Islands. First deliveries from the fabricating and processing plant are slated for this month.

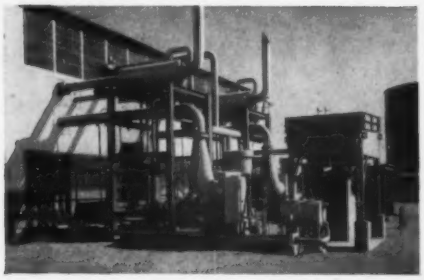
Cities Service Gas Co. wants to install 66 miles of pipe up to 30-in. diameter and add a 2140-hp compressor. Also proposed in Docket G-17941 is the development of the depleted Denton and Ferguson gas fields in Elk county, Kan., for underground storage. Estimated cost is $8.2 million.

About 6.4 miles of 24-in. line and 1500-hp additions to its Pavonia station are planned by Ohio Fuel Gas Co. The company will spend $865,000 on the job, proposed in Docket G-18252.

New York State Natural wants to construct 29.5 miles of 20-in. line and two measuring and regulating stations. Cost would be $1.6 million. New York Natural also plans to stop selling up to about 5.5 MMcf annually to Penn-York Natural Gas Corp. This calls for abandoning 11.7 miles of 10-in. line and a metering station. The gas would then be delivered directly to Iroquois Gas Corp., at the request of both Penn-York and Iroquois.

COMPRESSORS AND

GENERATORS ARE



MAXIM-QUIET

The new Needles, California Compressor Station operates with quiet efficiency. Maxim Silencers cut down exhaust noise and intake pulsation to the minimum. Specify the world's most widely used silencer—a Maxim. There's no quiet like *Maxim-Quiet*.

Photos courtesy of Southern California and Southern Counties Gas Companies

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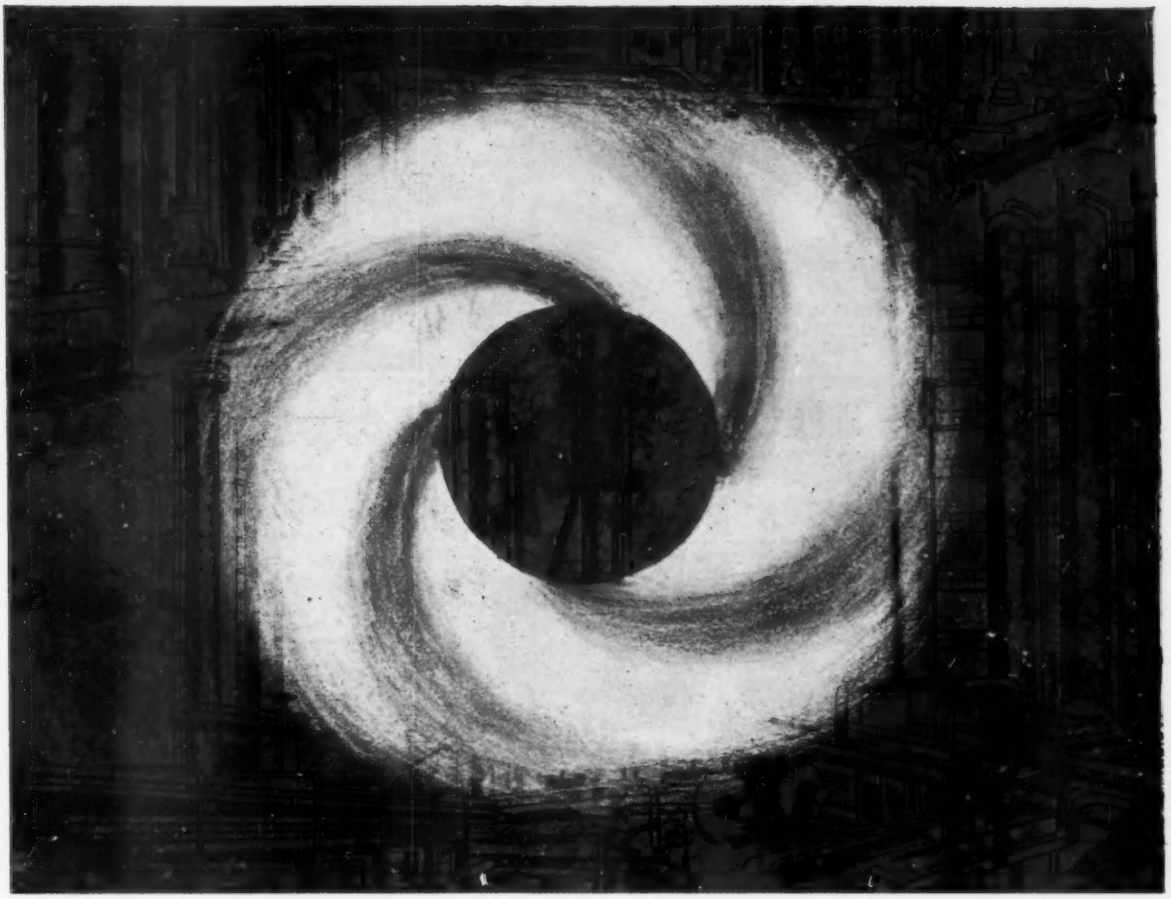

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MORE

GAS TURBINE HORSEPOWER

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Of the total installations in the world, one out of every three gas turbine compressor drives used in the petroleum industry has been designed by Brown & Root. Today, over 1,735,000 horsepower of the relatively new gas turbine drive is at work in various branches of the industry.

With its own forces, Brown & Root has installed 75 per cent of the units it has designed, and is familiar with — and has used components of — all U. S. and many foreign gas turbine manufacturers.

In the over-all field of gas compression and power generation, Brown & Root has designed and installed a total of 1,620,000 horsepower.

If you are planning a gas turbine installation — anywhere in the world — your inquiry will receive our prompt attention . . . with no obligation.

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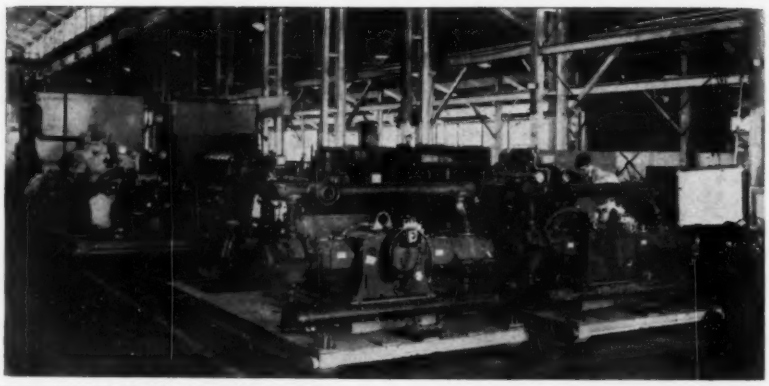
Equitable Gas Co.'s deliverability will be increased by 12 MMcf daily with recently approved construction. The $1.2 million plan covers 12.5 miles of 16-in. loops in West Virginia and an 880-hp compressor unit at the Pratt station in Greene county, Pa.

Hope Natural Gas Co.'s construction of 20 miles of 24-in. line has FPC approval. Also involved in the $2.1 million program are two metering stations in West Virginia. The new line replaces two old 16-inchers (Docket G-17588).



Clark Bros. Co. has expanded its facilities for packaging its line of field compressors. The new operation is located at the Beaumont, Texas, plant of Ideco Inc., another of the Dresser Industries. Western and southwestern U. S. will benefit from the new operation. At Beaumont, units will be mounted on skids, equipped with all necessary piping, and tested prior to delivery at the field site.

New York State Natural Gas Corp. is building newly okayed facilities costing $4.4 million. Forty miles of 20-in. and 1.6 miles of 6-in. line will be put in. Compressor increases are planned for Greene and Westmoreland counties, Pa. (1750 and 1320 hp each), and at Herkimer county, N. Y. (2000 hp).

Librascope Inc. is building a major addition to its Glendale, Calif., headquarters. The 82,000-sq ft addition will be used for assembling electronic computers and other equipment being developed.

Southern Pipe is offering a new concept in line pipe buying which cuts red tape and lowers cost. The Azusa, Calif., division of U. S. Industries calls the method "packaged pipelines." It brings together under one purchase order every step in the specification, production, processing and delivery of line pipe. The problem of random-length pipe is eliminated by cutting each unit to the exact specified length.

M. J. Crose Manufacturing Co. is distributing Johns-Manville fiber glass pipeline products. Crose already handles J-M asbestos felts. Crose headquarters office is in Tulsa, with branches in Houston, Denver, and Elizabeth, N. J. Crose-Curran Ltd. is in Edmonton, Alberta, Canada.

PROVED BY MILES & MILES & MILES &

GAS CALENDAR

August

24-26..Appalachian Gas Measurement Short Course—West Virginia University, Morgantown.
26-28..Mid-West Gas Association Gas School & Conference—Iowa State College, Ames, Iowa.

September

4..New Jersey Gas Association Annual Convention—Berkeley-Carteret Hotel, Asbury Park, N. J.
9-11..Pacific Coast Gas Association Annual Meeting—Ambassador Hotel, Los Angeles.
14-18..AGA Industrial Gas School—Penn-Sheraton Hotel, Pittsburgh.
15-16..AGA Accident Prevention Conference—Dinkler Plaza Hotel, Atlanta, Ga.
17-18..AGA Great Lakes Public Relations Workshop—Dearborn Inn., Dearborn, Mich.
24..NEGA Safety Conference—Sheraton Plaza, Boston

October

5-7..American Gas Association Annual Convention—Conrad Hilton Hotel, Chicago.
8-9..California Natural Gasoline Association Annual Fall Meeting—Huntington-Sheraton Hotel, Pasadena.
13-14..Gas Measurement Institute—National Guard Armory, Liberal, Kan.
14-16..Wisconsin Utilities Association Operating & Sales Convention—Shroeder Hotel, Milwaukee.
26-27..Independent Natural Gas Association of America Annual Meeting—Westward Ho Hotel, Phoenix, Ariz.
29-30..Oil Recovery Symposium on Southwest Texas (Sponsored by Southwest Section of AIME and Texas Petroleum Research Committee)—Driscoll Hotel, Corpus Christi, Texas.

February 1960

29-Mar. 2..AGA General Management Section Conference—Pittsburgh-Hilton Hotel, Pittsburgh, Pa.

March

14-18..National Association of Corrosion Engineers Annual Convention—Dallas.
21-23..Mid-West Gas Association Annual Meeting—Hotel St. Paul, St. Paul, Minn.
24-25..New England Gas Association Annual Meeting—Hotel Statler, Boston.
30-April 1..GAMA Annual Meeting—The Greenbrier, White Sulphur Springs, W. Va.

April

20-22..Indiana Gas Association—French Lick-Sheraton Hotel, French Lick, Ind.
25-27..Southern Gas Association Annual Convention—Galveston, Texas.

May

9-13..AGA Operation Section, Joint Distribution and Transmission Conference—Hotels Roosevelt and Jung, New Orleans.
16-18..AGA-Mid-West Regional Gas Sales Conference—Edgewater Beach Hotel, Chicago.
23-25..AGA Operating Section Production Conference—Hotel Roosevelt, New York.

corrosion • *Continued*

from page 19

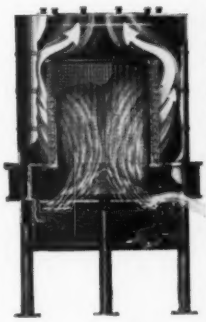
large distribution system were found to be insulated. No devices had been installed for the purpose. Investigation disclosed that a thread compound was in use there, the special creation of the maintenance foreman, composed of dry Portland cement and linseed oil! It was serving *his* purpose quite well. It made a good gas-tight joint. It was also serving, though not quite reliably, another and unwanted purpose, that of insulating the services from the mains.

The same kind of problem is frequently encountered in bell-and-spigot cast iron pipe, where cement, sulfur, and other sealing compounds are often used. Even well-caulked lead can form a watertight joint without establishing contact. The asphalt dip may be enough to insulate against the very low voltages of cathodic protection, and the temperature of the lead is not enough to remove the asphalt.

Some of the problems introduced by human frailties will be discussed in the next issue. ■

LOW PRESSURE DROP OIL BATH AIR FILTER

for turbocharged engines, compressors, blowers



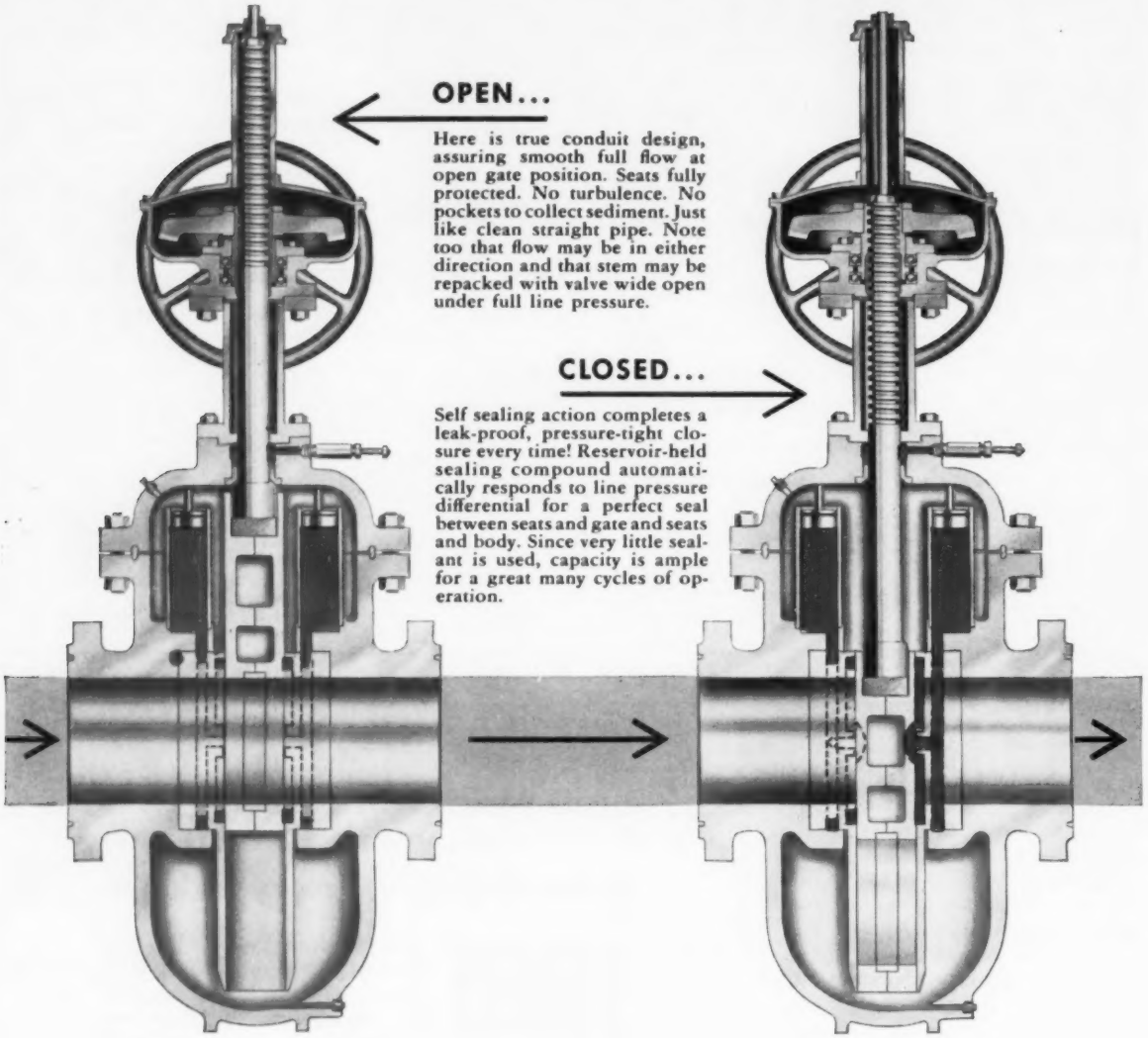
The Air-Maze Type LPD (Low Pressure Drop) oil bath air filter makes possible low static pressure loss operation without any outside energy or moving parts whatever. As a result, it offers particular benefits in cleaning of intake air on turbocharged stationary engines, since pressure losses of silencers, piping, elbows and air cleaners are additive.

Built specifically for larger range air flows, it offers resistances as low as 1" of water. As shown in the illustration, oil-scrubbing of intake air is accomplished by reversing the conventional oil and air current. Thus, low pressure loss is attained without sacrifice in efficiency, or oil washing action. There are no moving parts. Service is limited to occasional draining and cleaning of an oil sump.

Available in sizes from 800 to 16,500 cfm. Write for Bulletin LPD-1055. The Air-Maze Corporation, Dept. GM-8, Cleveland 28, Ohio.

It's an "Open and Shut" case for...

DARLING-McEVOY CONDUIT GATE VALVES



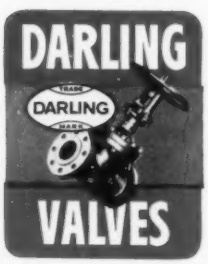
OPEN...

Here is true conduit design, assuring smooth full flow at open gate position. Seats fully protected. No turbulence. No pockets to collect sediment. Just like clean straight pipe. Note too that flow may be in either direction and that stem may be repacked with valve wide open under full line pressure.

CLOSED...

Self sealing action completes a leak-proof, pressure-tight closure every time! Reservoir-held sealing compound automatically responds to line pressure differential for a perfect seal between seats and gate and seats and body. Since very little sealant is used, capacity is ample for a great many cycles of operation.

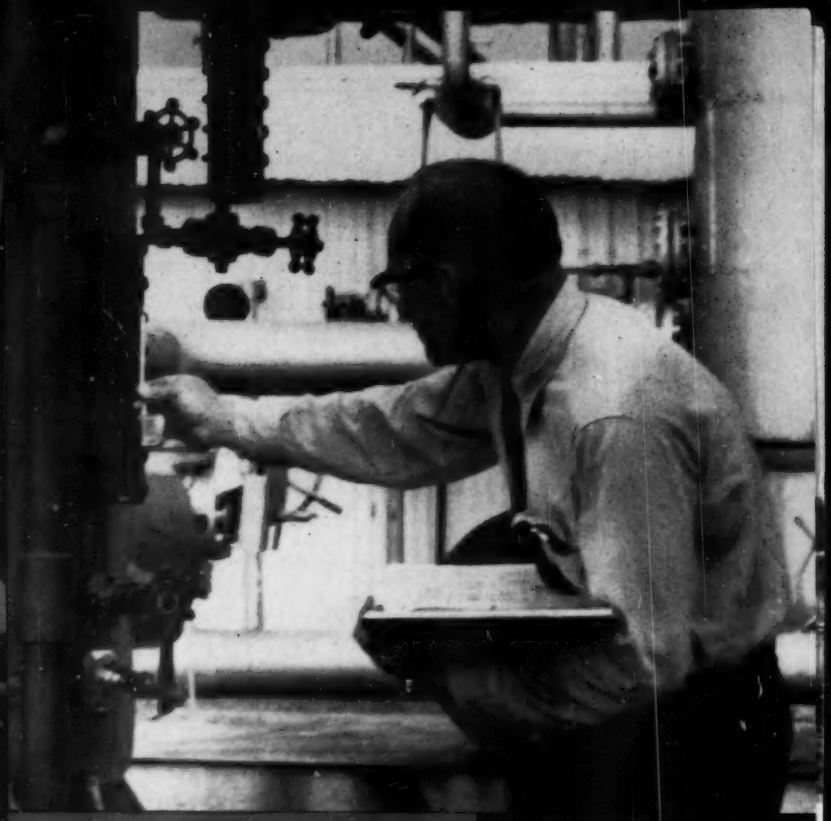
THESE and other features combine to make Darling-McEvoy conduit gate valves unique and unmatched in pipe line service today. They are now available in 4″ and larger sizes, fully field proved, with experience a matter of record on various major lines. For detailed information ask for Bulletin 5402.



DARLING VALVE & MANUFACTURING COMPANY

Williamsport 26, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.



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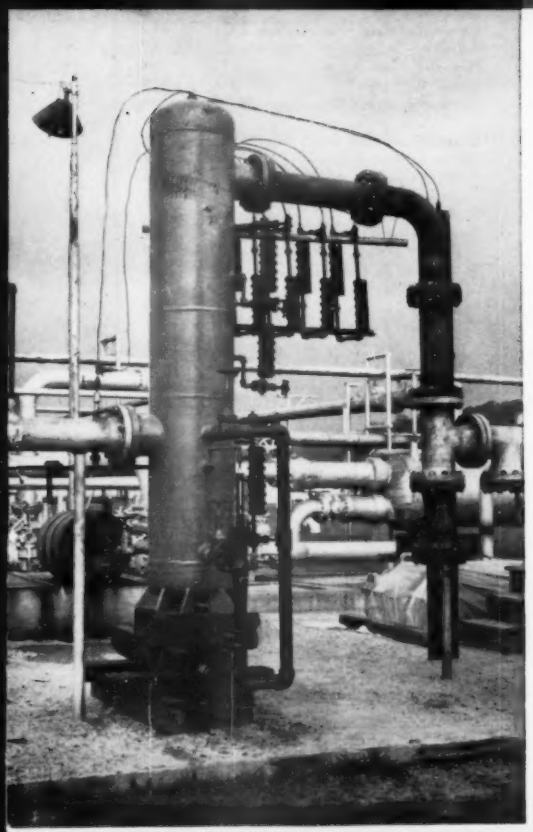

. . . A.G.A.'s giant step toward cleaner gas

You're looking at the test site of a vital research project sponsored by the American Gas Association. Six competitive gas cleaners—including Blaw-Knox—were studied for cleaning and oil loss efficiencies.

It was an important step . . . the first time gas cleaners have been so scientifically and impartially tested. The project set the stage for continuing research to improve gas cleaner performance.

Following the test, Blaw-Knox was the first to build a new pace-setting "Multi-Phase" cleaner. Now proven by our extensive supplemental testing, the Blaw-Knox "Multi-Phase" cleaner surpasses previous performance for low oil loss while cleaning gas of even sub-micron size foreign particles.

Blaw-Knox is proud to have been part of the A.G.A. project. From it comes the best gas equipment in Blaw-Knox's history to assure you of cleaner gas at lower cost. Let Blaw-Knox give you more details. Write . . .

BLAW-KNOX

BLAW-KNOX COMPANY
Buflovak Equipment Division
1547 Fillmore Avenue, Buffalo 11, N.Y.

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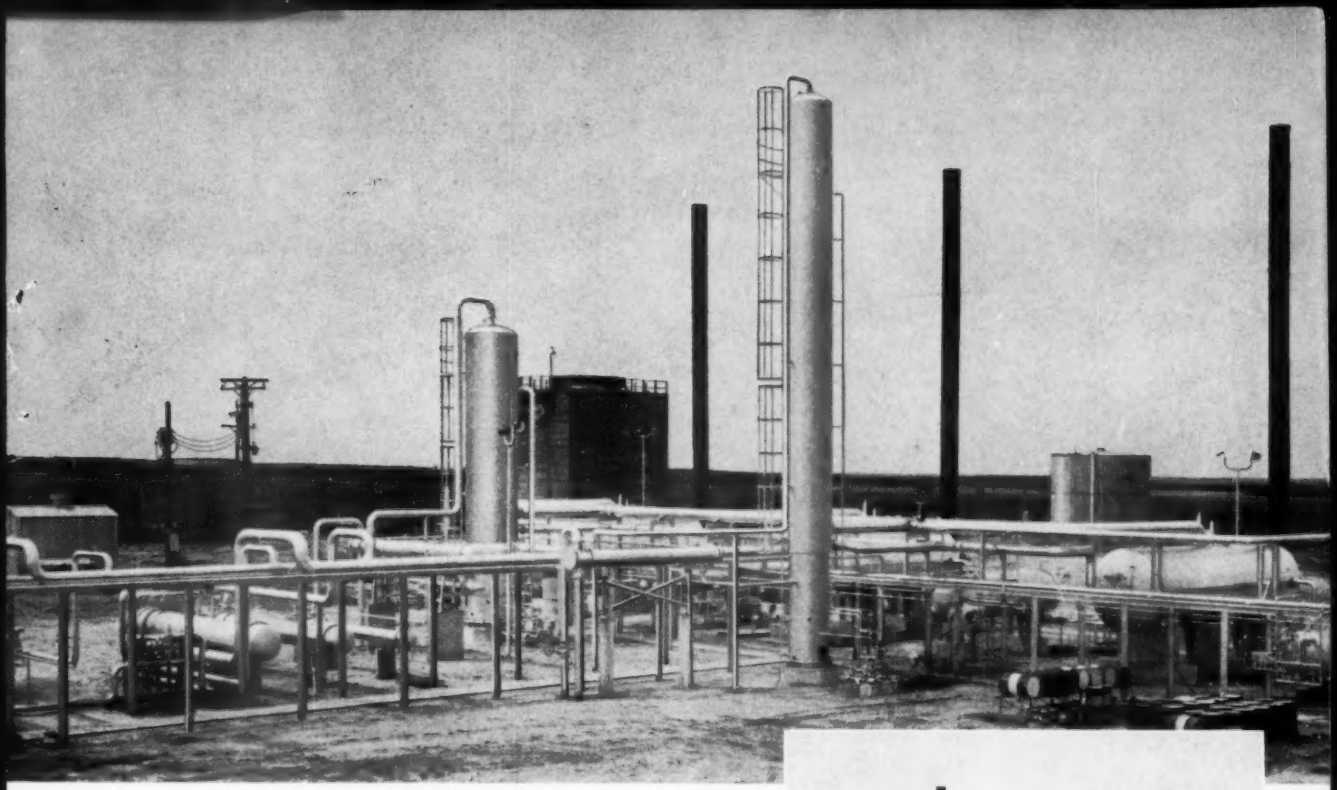

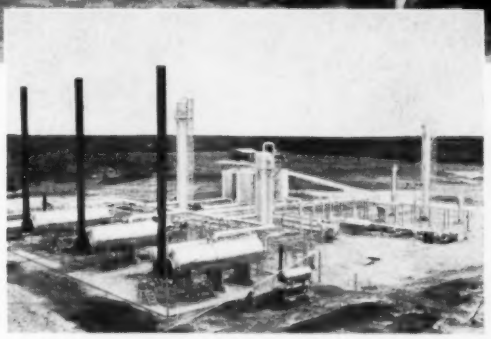

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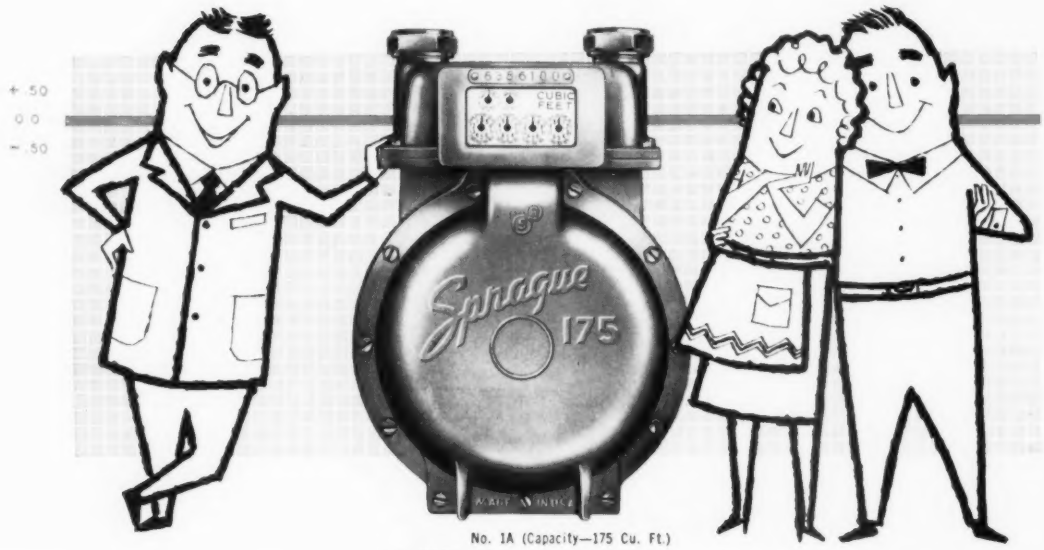

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